# New Bedford Harbor Superfund Site

## U.S. Army Corps of Engineers New England District

## Final Technical Memorandum Summary of Findings 2016 Investigation Update – Aerovox Near Shore Area

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| Project manager: | Steve Fox |
| Author: | Michael Morris |

Jacobs
103 Sawyer Street
New Bedford, MA  02746
508-996-5462
508-996-6742
www.jacobs.com

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# Acronyms and Abbreviations

| | |
|---|---|
| ACO | Administrative Consent Order |
| AECOM | AECOM Technical Services Inc. |
| Aerovox Corp. | Aerovox Corporation |
| Aerovox Inc. | Aerovox Incorporated |
| Aerovox Site | former Aerovox Corporation property |
| AVX | AVX Corporation |
| BBL | Blasland, Bouck & Lee, Inc. |
| CDF | confined disposal facility |
| CERCLIS | Comprehensive Environmental Response, Compensation, and Liability Information System |
| cis-1,2-DCE | cis-1,2-dichloroethene |
| CMR | Code of Massachusetts Regulations |
| CSA | comprehensive site assessment |
| cy | cubic yards |
| DNAPL | dense non-aqueous phase liquid |
| EE/CA | engineering evaluation/cost analysis |
| EPA | United States Environmental Protection Agency |
| ESD | Explanation of Significant Difference |
| ft | feet |
| GHR | GHR Engineering Corporation |
| Harbor Site | New Bedford Harbor Superfund Site |
| IA | immunoassay |
| in | inch |
| Jacobs | Jacobs Engineering Group, Inc. |
| MassDEP | Massachusetts Department of Environmental Protection |
| MCP | Massachusetts Contingency Plan |
| mg/kg | milligrams per kilogram |

| | |
|---|---|
| mg/L | milligrams per liter |
| MIP | membrane interface probe |
| NAVD88 | North American Vertical Datum of 1988 |
| NCP | National Contingency Plan |
| NTCRA | non-time critical removal action |
| OU | operable unit |
| PCB | polychlorinated biphenyl |
| ppm | parts per million |
| RAP | remedial action plan |
| RCRA | Resource Conservation and Recovery Act |
| ROD | Record of Decision |
| TCE | trichloroethene |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSCA | Toxic Substances Control Act |
| USACE | Unites States Army Corps of Engineers |
| UVOST | ultraviolet optical screening tool |
| VOC | volatile organic compound |
| WHG | Woods Hole Group |
| yr BP | years before present |

# Abstract

The former Aerovox capacitor manufacturing plant at 740 Bellevue Avenue was the primary source of polychlorinated biphenyl (PCB) discharges to the Acushnet River and New Bedford Harbor. The former facility consisted of a three-story textile mill, purchased in 1938 by Aerovox Corporation (Aerovox Corp.) and subsequently converted for capacitor manufacturing operations. Aerovox Corp., and a subsequent owner/operator, Aerovox Incorporated (Aerovox Inc.), used dielectric fluid containing PCBs in many of their products (capacitors) from the 1940s until a ban was placed on their use in the late 1970s. In 2008, as part of the remediation of PCB-contaminated sediment conducted pursuant to a 1998 Record of Decision (ROD), as modified, for the New Bedford Harbor Superfund Site, approximately 6,900 cubic yards (cy) of highly contaminated sediment abutting the Aerovox shoreline was removed using land-based mechanical excavation.

In July 2012, twelve sediment/soil borings were advanced to bedrock in the near-shore Aerovox area to obtain a vertical profile of remaining PCBs and select solvents in and under the marine sediments. These 12 borings were collected to understand the relationship between the Aerovox Site and the harbor.

An investigation was conducted by AVX Corporation (AVX) on the Aerovox Site between October 2013 and August 2015 as part of its state 21E Phase II comprehensive site assessment (CSA) to define the nature and extent of contamination. Investigation activities included characterization tools such as seismic refraction, membrane interface probe (MIP) and hydraulic profiling tool, ultraviolet optical screening tool (UVOST), direct push soil borings, and monitoring wells. During the course of this investigation dense non-aqueous phase liquid (DNAPL) was identified in two monitoring wells.

An additional investigation of the sediments in New Bedford Harbor adjacent to the Aerovox Site was conducted in August 2015. A series of 21 borings were placed around locations previously sampled in 2012 to fill in data gaps noted from the previous investigation. In November 2015, an additional eight sonic borings were placed in the harbor to address some data gaps and provide more information at depth for several locations.

These investigations identified subsurface areas within the Aerovox Site and New Bedford Harbor that have contamination related to the former activities conducted at the Aerovox Plant. This contamination was discharged to two major drainage ditches that at one time ran nearly the entire length of the now demolished plant and indicating that it has traversed the original sheet pile wall installed to limit transport into the harbor. DNAPL has been found on the site and in the harbor, and in one location on the shoreline has migrated to top of bedrock. This investigation concludes that contamination remaining on the Aerovox Site has the potential to migrate into the harbor sediments if left unaddressed.

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# 1.0 Introduction

This Technical Memorandum discusses the results of the soil and sediment sampling adjacent to and on the Aerovox Site between 2012 and 2016 (Woods Hole Group [WHG] 2013; AECOM Technical Services Inc. [AECOM] 2015; Battelle 2016), and combines those results with data and findings from historic soil sampling activities in and around the former Aerovox facility (GHR Engineering Corporation [GHR] 1983; Gushue and Cummings 1984; and Blasland, Bouck & Lee, Inc. [BBL] 1998). This report provides an updated description of the near-shore sediment contamination and on–shore soil contamination from the former Aerovox Corporation property (Aerovox Site), located at 740 Belleville Avenue in New Bedford, Massachusetts (Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS] ID MAN000103307). As part of the 2012 near-shore boring program, samples were taken from sediment located within the New Bedford Harbor Superfund Site (Harbor Site), immediately east of the Aerovox Site. Soils data were collected on the Aerovox Site between October 2013 and August 2015 as part of a Phase II Investigation. Additional borings in the harbor were collected in August and November 2015 to account for data gaps noted in the 2012 sediment investigation. This Technical Memorandum was prepared for the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) by Jacobs Engineering Group, Inc. (Jacobs).

This Technical Memorandum was prepared as a summary and interpretation of the available soil and sediment data from various investigations to be used in the design and scheduling of further dredging along the shoreline as part of the overall remediation of the Harbor Site. In addition, the combined geologic and contaminant data collected through this boring program may be useful in the planned 21E action for the Aerovox Site.

## 1.1 Background on the New Bedford Harbor Superfund Site

The Harbor Site is located in Bristol County, Massachusetts, and extends from the shallow northern reaches of the Acushnet River estuary south through the commercial harbor of New Bedford and into 17,000 adjacent acres of Buzzards Bay. Industrial and urban development surrounding the harbor has resulted in sediment becoming contaminated with high concentrations of many pollutants, notably polychlorinated biphenyls (PCBs) and heavy metals, with contaminant gradients decreasing from north to south. The Harbor Site is divided into three areas, the Upper, Lower and Outer Harbors - consistent with geographical features of the area and gradients of contamination. The Harbor Site is also defined by three state-sanctioned fishing closure areas extending approximately 6.8 miles north to south and encompassing approximately 18,000 acres in total.

There are currently three operable units (OUs) at the Harbor Site: OU1 - the Upper and Lower Harbor; OU2 - the hot spot operable unit, consisting of some of the Harbor Site's most highly PCB-contaminated sediment (concentrations greater than 4,000 parts per million [ppm]) located near the Aerovox Site; and OU3 - the Outer Harbor.

The Upper Harbor comprises approximately 187 acres. The boundary between the Upper and Lower Harbor is the Coggeshall Street Bridge. The Lower Harbor comprises approximately 750 acres. The boundary between the Lower and Outer Harbor is the New Bedford hurricane barrier which was constructed between 1962 and 1966. The Outer Harbor is comprised of approximately 17,000 acres with its southern extent (and the Harbor Site's boundary) formed by an imaginary line drawn from Rock Point (the southern tip of West Island in Fairhaven) southwesterly to navigational Buoy C3 and then southwesterly to Mishaum Point in Dartmouth (Figure 1-1).

Identification of PCB-contaminated sediment and seafood in and around New Bedford Harbor was first made in the mid-1970s as a result of EPA region-wide sampling programs. The manufacture and sale of PCBs was banned by the Toxic Substances Control Act (TSCA) in 1979. The Massachusetts Department of Public Health promulgated regulations in 1979 prohibiting fishing, shellfishing and lobstering within areas of the Harbor Site due to elevated PCB levels in area seafood. Designated by the Commonwealth of Massachusetts, pursuant to 40 C.F.R. § 300.425(c)(2) of the National Contingency Plan (NCP), as its highest priority site, the New Bedford Site was proposed for inclusion on the Superfund National Priorities List in 1982, and finalized on the National Priorities List in September 1983.

EPA's Harbor Site-specific investigations began in 1983 and 1984 (Metcalf & Eddy Engineers 1983; NUS Corporation 1984a, 1984b). Harbor Site investigations continued throughout the rest of the 1980s and early 1990s, including a pilot dredging and disposal study in 1988 and 1989 (Otis et al. 1990), a baseline public health risk assessment in 1989 (Ebasco Services Incorporated 1990), computer modeling of site cleanup options, and an updated feasibility study for the Harbor Site completed in 1990 (Battelle Memorial Institute 1990; Ebasco Services Incorporated 1990). These investigations found that hazardous substances, particularly PCBs, were released, deposited, disposed of, or placed at the Aerovox facility which manufactured PCB-impregnated electrical capacitors from at least 1947 through 1973. Various solvents were also used in manufacturing operations (Versar 1981). The Aerovox Site was found to be the primary source of PCBs released at and to the Harbor Site through operations and disposal practices that occurred at the Aerovox Site. PCBs were released, deposited, disposed, placed, or came to be located at the Harbor Site, or migrated, and may still be migrating, to the Harbor Site from the Aerovox Site by several pathways including;

- direct and indirect disposal at and from the Aerovox facility,
- discharges of PCB wastes from the Aerovox facility through unlined and later lined trenches and discharge pipes directly to the Upper Harbor; the drainage and release of PCBs into the Upper Harbor as a result of PCBs leaked and spilled onto the floor of the Aerovox facility building and the grounds outside the building,
- indirect disposal of PCBs to the harbor via storm drains and combined sewer overflows,
- leaking of PCBs from the Aerovox facility to the groundwater underlying the facility and discharges of that groundwater to the harbor, and
- leaking of PCBs from PCB-impregnated capacitors discarded on tidal flats within the harbor adjacent to the Aerovox facility.

PCBs were also released to the Harbor Site from the Comell-Dubilier Electronics, Inc. facility just south of the hurricane barrier in New Bedford. Studies performed on sediment in the harbor, surface water, shoreline, and biota at the Harbor Site demonstrate decreasing north to south gradients of PCB levels as the distance from the Aerovox Site increases, with the highest concentrations of PCBs detected in the northern portion of the Harbor Site. Sediment within the Harbor Site also contains high levels of other hazardous substances, including heavy metals (e.g., cadmium, chromium, copper, and lead) (Summerhayes et al. 1977; Pruell et al. 1988; Schwartz 1988; Lake et al. 1990).

In April 1990, EPA issued a Record of Decision (ROD) for OU2 at the Harbor Site ("1990 OU2 ROD" or "Hot Spot ROD") (EPA 1990). The 1990 OU2 ROD called for dredging and on-site incineration of sediment above 4,000 ppm PCBs in the vicinity of the Aerovox facility. Dredging and temporary disposal of this sediment – about 14,000 cubic yards (cy) in volume and 5 acres in area - began in April 1994 and was completed in September 1995. Pursuant to an April 1999 amendment to the 1990 OU2 ROD, the sediment was dewatered and transported to an offsite landfill for permanent disposal. This final offsite disposal phase of the hot spot remedy was completed in May 2000.

The Upper and Lower Harbor OU1 ROD (1998 OU1 ROD) was issued on September 25, 1998 (EPA 1998). The 1998 OU1 ROD called for approximately 450,000 cy of PCB-contaminated *in situ* sediment to be dredged from the harbor bottom and surrounding wetlands, and to be disposed in perpetuity in four shoreline confined disposal facilities (CDFs), long-term monitoring, and institutional controls[1].

Since the issuance of the 1998 OU1 ROD, EPA has gathered additional site information and refined the cleanup approach for the Upper and Lower Harbor areas through five Explanations of Significant Difference (ESDs) (EPA 2001; 2002; 2010; 2011, and 2015). The ESDs explained that the total *in situ* sediment volume above the OU1 ROD cleanup standards was estimated to be approximately 900,000 cy.

During the 2006 dredging season for the Harbor Site, high concentrations of volatile organic compounds (VOCs) were found in addition to elevated PCB concentrations in sediment immediately adjacent to the Aerovox Site. In 2008, EPA mechanically excavated approximately 6,900 cy of this contaminated sediment along the shoreline of the Aerovox Site and further characterized the presence of very high levels of PCBs and VOCs, particularly trichloroethene (TCE) and this compound's breakdown products (cis-1,2-dichloroethene [cis-1,2-DCE] and vinyl chloride) at the Harbor Site. The Toxicity Characteristic Leaching Procedure (TCLP) testing on this material showed that this sediment exceeds the Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste standards for toxicity due to the presence of TCE with concentrations ranging from 0.130 milligrams per liter (mg/L) to 43.0 mg/L. The regulatory TCLP limit for TCE to be a RCRA characteristic hazardous waste is 0.5 mg/L. This contaminated sediment is currently being stored in a lined and capped cell

[1] An additional 126,000 cubic yards of contaminated sediment would be contained within the footprintsof the CDFs.

located at EPA's Sawyer Street facility (Jacobs 2007). Groundwater and air monitoring is routinely conducted around and near the cell.

EPA initiated an investigative boring program directly seaward (eastward) of the Aerovox site in 2012 in an effort to characterize the geology and extent of chemical contamination from the sediment surface to bedrock. Twelve borings were advanced by WHG with support from Jacobs (WHG 2013).

An investigation was conducted by AVX on the Aerovox Site between October 2013 and August 2015 as part of a Phase II comprehensive site assessment (CSA) to define the nature and extent of contamination. Investigation methods included seismic refraction survey, membrane interface probe (MIP)/hydraulic profiling tool, ultraviolet optical screening tool ( UVOST), direct push soil borings, and monitoring wells. During the course of this investigation dense non-aqueous phase liquid (DNAPL) was identified in two monitoring wells. The presence of DNAPL constitutes a Massachusetts Contingency Plan (MCP) reporting condition, and DNAPL recovery activities are ongoing (Brown and Caldwell 2016).

In August 2015, an additional investigation of the sediments in New Bedford Harbor adjacent to the Aerovox Site was conducted. An additional 21 borings were installed around locations previously sampled in 2012 to fill in data gaps noted from the previous investigation. An additional eight sonic borings were placed in the harbor to address some data gaps and provide more information at depth for several locations. This investigation was conducted in November 2015 (Battelle 2016). This technical memorandum evaluates the on- and off-shore soil and sediment data collected during these three investigations. This technical memorandum provides the bases for the interpretation of the geology, PCB, and VOC distribution in soils and sediments on the Aerovox Site and in New Bedford Harbor.

## 1.2 Background on the Aerovox Facility

The Aerovox Site facility is located on an approximately 10.3-acre, industrially zoned parcel at 740 Belleville Avenue in New Bedford, Massachusetts (Figure 1-1). The facility (Figure 1-2), which directly abuts the harbor, consisted of a former three-story textile mill, purchased in 1938 by Aerovox Corp. and subsequently converted for capacitor manufacturing operations. Aerovox Corp., and a subsequent owner/operator, Aerovox Inc., used dielectric fluid containing PCBs in many of their products (capacitors) from the 1940s until a ban was placed on their use in the late 1970s. Aerovox Corp. and Aerovox Inc. also utilized TCE in the manufacturing process as a degreasing solvent (Versar 1981).

Inspections and sampling conducted at the Aerovox facility in the late 1970s and early 1980s led to a 1982 administrative order with EPA and a consent agreement with Massachusetts Department of Environmental Quality Engineering (now named the Massachusetts Department of Environmental Protection [MassDEP]) that required Aerovox Inc.'s performance of protective measures to prevent the spread of existing PCB contamination from the facility. These measures included installation of a hydraulic asphalt concrete cap over soils on the northeast and eastern sides of the property and the installation of a steel sheetpile wall along the shoreline to isolate PCB-contaminated soils and a shallow perched aquifer beneath the Aerovox facility from the harbor. These remedial actions were implemented in 1983-1984 (Gushue and Cummings 1984). A subsequent agreement between the parties in 1984 required Aerovox Inc. to commence and carry out a long-term monitoring and maintenance program, including compliance with the reporting requirements outlined in the program, and to take maintenance measures as necessary to maintain on-site containment and prevent the release of PCBs.

A site inspection by EPA in 1997 (and an EPA Approval Memorandum in 1998) lead to an Engineering Evaluation/Cost Analysis (EE/CA) conducted by Aerovox Inc. at the Aerovox Site which revealed extensive PCB contamination within the plant. The EE/CA recommended building demolition with onsite and offsite disposal of PCB-contaminated building debris, followed by capping (BBL, 1998).

An administrative order entered into between EPA and Aerovox Inc. in 1999 to conduct the building demolition and capping was not completed when Aerovox Inc. vacated the building and soon after filed for bankruptcy in 2001. A bankruptcy settlement in 2003 with Aerovox Inc. provided limited funds to address the Aerovox Site contamination. A Time Critical Removal Action was conducted by EPA in 2004 to remove barrels containing hazardous waste and to seal cracks in the existing cap. In April 2006, EPA issued a supplement to the 1998 EE/CA (Supplemental Engineering Evaluation/Cost Analysis) (EPA 2006).

In March 2006, EPA prepared a conceptual site model which provided a summary of available information regarding PCB contamination present at the Aerovox Site (ENSR 2006). Existing site data were reviewed, and a limited investigation was performed to provide additional information on storm water runoff from the Aerovox Site and groundwater beneath the Aerovox Site. The combined data provided a screening-level assessment of PCB transport in surface water runoff and groundwater discharge from the Aerovox Site to the adjacent waters of the Harbor Site that showed a very low potential for significant transport (ENSR 2006). The assessment noted that deterioration of the building shell could increase the potential for mobilization and transport of PCBs.

On January 27, 2010 EPA issued an action memorandum for a non-time critical removal action (NTCRA) to achieve a controlled demolition of the Aerovox Site facility, offsite disposal of waste material, capping and implementation of post-removal site control measures. On June 3, 2010, an Administrative Settlement Agreement and Order on Consent was entered into between EPA and AVX, which is the successor of Aerovox Corp., for the Aerovox Site. Pursuant to the Settlement Agreement, AVX demolished the building and capped the Site. Demolition was completed in December 2011. The majority of the building debris was trucked off-site for TSCA disposal by the City of New Bedford through a Cooperative Agreement with EPA. The building's foundation was filled with compacted clean material and capped with asphalt. Except for a small strip on the western edge along Belleville Avenue, the existing asphalt cap was covered with new asphalt. The hydraulic asphalt concrete cap covering the eastern portion of the Aerovox facility site was partially covered with asphalt and some cracks were sealed (Jacobs 2012).

Also on June 3, 2010, an administrative settlement entered into, by, and between the Commonwealth of Massachusetts and AVX entitled Administrative Consent Order (ACO) and Notice of Responsibility, involving the assessment and cleanup of the Aerovox Site pursuant to Massachusetts General Law Chapter 21E and the regulations promulgated there under the MCP, 310 Code of Massachusetts Regulations (CMR) 40.0000. Through this ACO, the extent of contaminated soil and groundwater will be assessed, additional site cleanup and/or capping needs will be evaluated and conducted pursuant to the state cleanup program and long-term groundwater monitoring and cap maintenance will be performed to address source control and groundwater contamination. Field activities for the building demolition for the NTCRA were initiated in April 2011 and completed in December 2011. The final report documenting the NTCRA was submitted in May 2012 and approved by EPA in May 2013.

Aerovox submitted a Phase I initial site investigation, Tier Classification, and Phase II Scope of Work in August 2013. MassDEP issued a Tier 1B Permit for the Aerovox Site and approved the Phase II scope of work on September 2013. Site investigations for the Phase II CSA were conducted between October 2013 and August 2015. The Phase III remedial action plan (RAP) was issued on August 2016 and included evaluation of a number of remedial action alternatives. The Phase III plan has been reviewed but has not been approved.

# 2.0 Site Geology

The Aerovox Site and the shoreline are located in southeastern Massachusetts, near the northern extremity of the Acushnet River estuary, north of Buzzards Bay, which opens into the Rhode Island Sound and the Atlantic Ocean. The regional geology is characterized by crystalline bedrock, eroded and contoured by Pleistocene glaciation into a series of low amplitude valleys and ridges. Glaciation is also responsible for the majority of the unconsolidated sediments overlying bedrock. These glacial deposits range from dense till to highly permeable outwash sand and gravel.

The geology and landscape of the Aerovox Site and the harbor primarily reflect the dynamic glacial and interglacial processes that affected much of the New England during the Pleistocene from the glacial maximum around 18,000 years before present (yr BP) to the full glacial retreat by 14,000 yr BP (Dyke and Prest 1987) (Figure 2-1) The advance and retreat of the glaciers in the area of New Bedford Harbor scoured the valleys and deposited poorly sorted till above the scoured bedrock surface. As the glaciers retreated, meltwater from the glaciers moved through the valley depositing thick lenses of poorly sorted sands and gravels with some glaciolacustrine deposits in the proglacial portions of the ice margin. Many of these outwash surfaces were stable enough to develop pedogenic features such as reddened colors and clay films on individual grains denoting paleosol development. As water levels began to rise, this terrestrial environment converted to a subaquatic regime with invasion by aquatic near-shore vegetation producing peat. As the water levels continued to rise, the peat was buried by marine deposits in the harbor. The extent of these marine deposits was determined by the eventual level of seawater in the harbor reflecting current landscape conditions. Some of the deposits have been historically modified by placement of buildings and structures around the Aerovox Site as well as the removal of sediments by active dredging in the Harbor Site.

Geologic cross sections were devised from the existing boring information and are represented on Figure 2-2. Two north to south cross sections (A-A' and B-B') present data from the 2012 Aerovox shoreline investigation (WHG 2013) and the 2015 data gap investigation (Battelle 2016) (Figures 2-3 and 2-4). Geologic boring logs are presented in the latest investigation reports (Jacobs 2013; AECOM 2015; Battelle 2016). In addition, five east to west cross sections (C-C', D-D', E-E', F-F' and G-G') were developed by combining historic information (GHR 1983, Gushue and Cummings 1984, and BBL 1998) with data obtained from later investigations (Figures 2-5, 2-6, 2-7, 2-8, and 2-9 respectively).

The general geologic sequence in the Aerovox area begins with crystalline bedrock ranging from mafic gabbro to schist. Bedrock is defined in all cross sections and generally ranges in elevation from approximately -5 feet (ft) to -39 ft North American Vertical Datum of 1988 (NAVD88). The bedrock surface generally slopes from west to east with the higher elevations occurring in the western portion of the Aerovox Site and the lower elevations within the Harbor Site (Figures 2-5 through 2-9). Bedrock is overlain by either glacial till or glacial outwash deposits. The glacial till is generally dense with high contents of silt and clay with angular to subangular gravels. The till was formed by the movement of the glaciers along the Acushnet Valley where glacial flour and poorly sorted sediments were carried with the glacier's movement down the valley. The angular gravels were formed from the cryoplanation of the glacier bottom in contact with the bare bedrock surface, "plucking" and incorporating the gravel into the dense, silty glacial flour matrix. The glacial till is observed primarily in the geologic section to the east of the sheet pile wall (Figures 2-3 and 2-4) and thins considerably to the west (Figures 2-5, 2-6, 2-7, 2-8, and 2-9). There is evidence of the glacial till under the Aerovox Site, although it is not as continuous as that displayed in the harbor geology.

Overlying the till and/or the bedrock is a relatively thick layer of glacial outwash. This feature consists of poorly sorted sands and rounded gravels with intermittent lenses of silts and clays. This unit was formed by the fluvial processes associated with retreating and melting glaciers. The volume of water moving down the valleys created a series of braided streams with intermittent glaciolacustrine deposits in proglacial lakes at the ice margins. These landforms may have been stable enough to support terrestrial vegetation for a period of time and, as a result, exhibits some characteristics of paleosol development including the presence of oxidized horizons from a former terrestrial regime. This outwash is present in all cross sections and ranges in thickness from 10 to 36 ft with the thicker deposits usually found in the harbor (Figures 2-3 and 2-4) gradually thinning to the west with some deeper deposits near the western boundary of the Aerovox Site (Figures 2-5, 2-6, 2-7, 2-8 and 2-9).

Above the glacial outwash is an intermittent deposit of peat. This deposit consists of plant fibers, preserved in the sediment due to reducing conditions and represents the transition from a terrestrial to an aquatic environment. This occurred after the glacial retreat and the subsequent sea level rise from the Pleistocene through the Holocene. The presence of the peat layer is intermittent in the harbor (Figure 2-3) and thickens to the west (Figures 2-5, 2-6, 2-7, 2-8 and 2-9). The peat thickness on the Aerovox Site is intermittent ranging from 0 ft in the west to 5 ft farther east. The peat is more continuous on the eastern portion of the site, then thins, and becomes less continuous and patchy to the west.

Post-glacial marine deposits are found in the upper sections of the landscape, particularly in the harbor geologic section. The thickness of this unit ranges from 30 ft in the harbor (A-A' in Figure 2-3) and thins to the west to about 2 ft. The unit is continuous in the east and discontinuous in the west (Figures 2-5 and 2-6). These deposits are characterized by silts, sands, and clays that were deposited as a result of an inundated marine environment. The sediments are better sorted than the glacial outwash and generally exhibit morphology indicative of deposition in a reducing environment (gray colors, sulfide odors). There are two main components of the marine deposits that have been characterized in the harbor. The upper organic silt unit is generally black in color, loose in consistency (sometimes described as "black mayonnaise"), often with petroleum odor. Studies have shown that most of the PCB contamination in the harbor is restricted to this upper sediment subunit (Morris et al. 2011). Below the organic silt is a dark gray silty clay to silty sand that is firmer in consistence and has a sulfur odor. The concentration of PCBs generally decline precipitously from the upper organic silt to the lower silty clay and silty sand. This unit is on average approximately 10 ft thick in the harbor and overlies the peat or the glacial outwash where the peat is discontinuous.

There is a unit identified as fill found primarily in the vicinity of the Aerovox Site with thin, discontinuous deposits found in the Harbor Site. This fill consists of poorly sorted gravels, sands, silts, and clays. The fill material generally contains pieces of building materials such as broken bricks and tiles. It also commonly has darkened matrices due to coal tar or petroleum. It is distinguished from the underlying marine and outwash deposits due to its poor sorting as well as the presence of man-made materials. This unit is found primarily on the Aerovox Site proper, although it has been observed above the marine deposits in the harbor in proximity to the shoreline. The fill usually overlies either peat or outwash deposits under the Aerovox Site west of the sheet pile wall.

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# 3.0 Distribution of Contaminants

A discussion of the nature and extent of the organic contaminants on the Aerovox Site and in the Harbor Site is presented below. Cross sections and plan view depictions were developed (Figures 3-1 to 3-17) using historic soils data from previous Aerovox investigations, including the 2012 shoreline investigation, the Phase II Aerovox investigations, and the 2015 supplemental shoreline investigation. These figures were developed to refine the understanding of the nature and extent of the contamination in this area. The remainder of this section is divided into separate presentations of PCBs and VOCs.

## 3.1 Soil and Sediment Collection Methods

Samples were collected differently between investigations on the Aerovox Site. Aerovox Site data were collected from monitoring wells, test borings, and soil borings executed using a hollow stem auger and sampled and/or described using a split spoon (GHR 1983; BBL 1998). Sediment cores from the Harbor Site during 2012 were collected using a barge-mounted mini-sonic rig and samples collected with Lexan liners (WHG 2013). Soil borings, MIP location samples, and UVOST location samples on the Aerovox Site were collected with a Geoprobe using a direct push method with five-foot core sections (AECOM 2015). Soil samples from monitoring well locations on the Aerovox Site were collected from boring installation by a drive and wash technique with a roller bit to construct an 8.5-inch (in) diameter boring (AECOM 2015). Harbor Site borings collected in 2012 were collected by a track-mounted mini-sonic rig, five-foot long steel core barrels with Lexan liners completed to bedrock (WHG 2013). Harbor borings collected in 2015 were completed with a combination of vibracore and mini-sonic methods (Battelle 2016). Details on the sampling and analytical methodologies can be found in the various investigation reports (WHG 2013; Jacobs 2013; AECOM 2015; Battelle 2016). Cross sections and plan view figures were developed to demonstrate the distribution of PCBs and VOCs on the Aerovox Site and in the harbor. The cross sections were developed from ones created in a previous investigation of near-shore harbor sediments (Jacobs 2013). Cross sections representing PCB and VOC concentrations at and adjacent to the Aerovox Site were developed from the previous investigation included cross sections A-A’ (Figures 3-1 and 3-10), B-B’ (Figures 3-3 and 3-11), C-C’ (Figures 3-4 and 3-12), D-D’ (Figures 3-6 and 3-14), E-E’ (Figures 3-7 and 3-15), and F-F’ (Figures 3-8 and 3-16). In this document, the cross sections have been updated with information collected from the Phase II Aerovox Investigation (AECOM 2015) on the Aerovox Site and the Aerovox Supplemental Investigation in the near shore harbor sediments (Battelle 2016). All of the historic data used in the previous investigations on the Aerovox Site have been replaced with updated information from the Phase II investigation (AECOM, 2015). Cross section G-G’ (Figures 3-9 and 3-17) was developed to capture important information regarding distribution of DNAPL on the Aerovox Site.

## 3.2 PCBs

PCB concentrations from the 2012 harbor borings (Jacobs 2013) as well as the Aerovox Site borings (AECOM 2015) are presented in the cross sections and plan views as total detected PCBs in samples from the borings based on a sum of the following Aroclors, which is the most common way to measure PCBs. Aroclor was the trade name of the commercial PCB mixtures manufactured by the Monsanto Chemical Company and sold in the United States. An Aroclor PCB mixture might consist of over 100 different PCB congeners, although 10-20 might make up over 50 percent of the mixture. Each Aroclor has a distinctive gas chromatographic pattern that is indicative of one of the Aroclors. The first two digits refer to the number of carbons on the phenyl rings and the last two digits indicate the percentage of chlorine by mass in the mixture. The nine most common PCB Aroclor mixtures were analyzed in the historic harbor and Aerovox Site investigations:

- Aroclor 1016
- Aroclor 1221
- Aroclor 1232
- Aroclor 1242
- Aroclor 1248
- Aroclor 1254
- Aroclor 1260
- Aroclor 1262
- Aroclor 1268

In an effort to reduce costs for sampling PCBs in the harbor, the sediment samples collected in 2015 were analyzed for PCBs by a combination of immunoassay (IA) screening analysis and sum of total congeners (Battelle 2016). IA is a technique that uses antibodies to identify and quantify organic compounds. Antibodies have been developed to bind with a target compound or class of compounds. Sensitive colorimetric reactions, linked to the immobilization of the target compound by the antibody, are used to identify analyte concentrations. The determination of the target analyte's presence is made by comparing the color developed by a sample of unknown concentration with the color formed by the standard containing the analyte at a known concentration. The concentration of the analyte is determined by the intensity of color in the sample. In this case, the IA analyses were calibrated to Aroclor 1254 with a lower response for Aroclor 1242. A limited number of samples were subjected to congener analysis where all 139 congeners of PCBs are measured and summed to develop a total PCB concentration (Battelle 2016). Samples subjected to IA or congener analysis were marked accordingly on the geology and PCB cross sections. High concentrations of PCBs are found along the A-A' transect from the 2012 (WHG 2013) and 2015 Aerovox shoreline investigations (Battelle 2016). This cross section is oriented north to south and parallels the shoreline with all borings located within 40 ft of the defined shoreline (Figure 2-1). Parts of this area have been previously dredged for mass removal as recently as 2008, with the exception of the southern portion (near ASB-7) which was dredged in 2011. Based on comparison to 1991 elevations, up to 6 ft of material has been removed in some areas since active dredging began (Jacobs 2013). The orientation of cross section A-A' reflects a groundwater flow path that generally runs perpendicular to and into the page indicating a flow from west to east. The highest PCB concentrations are found in borings ASB-1 and ASB-3 (Figure 3-1). The location of the two main concentration centers (borings ASB-1 and ASB-3) align with the two drainage swales or trenches that paralleled the north and south sides of the former Aerovox building east to the harbor (Figures 2-1 and 3-2).

Another area of elevated PCBs is found in boring ASB-5 and is aligned with a storm water outfall from the parking area to the harbor. Boring ASB-1 has the highest concentration of PCBs (8,350 milligrams per kilogram [mg/kg]) on the A-A' cross section. This contamination was found 4.0 ft below the sediment surface in the outwash deposits and below the organic silts (Figure 3-1). Supplemental boring ASB-17 showed elevated concentrations of PCBs deeper in the section. The boring was located between ASB-1 and the sheetpile wall to further delineate contamination from the Aerovox Site. Five samples were collected between 6.5 and 13 ft below the sediment surface, all within the glacial outwash deposits, ranging from 180 to 2,700 mg/kg. In boring ASB-1, 4.85 mg/kg is found 16.7 ft below the surface , also in the glacial outwash. Concentrations are lower in the underlying glacial till.

The highest concentrations of PCBs in boring ASB-3 are found primarily in the organic silt layer (2,030 and 3,580 mg/kg), but elevated concentrations also extend below the organic layer into the lower marine and into glacial outwash deposits (Figure 3-1). The supplemental investigation also found elevated concentrations of PCBs in the marine and outwash deposits from 1,900 mg/kg at 1 ft to 670 mg/kg at 11 ft below the sediment surface in ASB-29. In addition, a concentration of 16.3 mg/kg was found in the glacial till which is the highest concentration found in the till. Concentrations greater than 10 mg/kg are found at ASB-28 and ASB-29 as deep as 21.0 ft below the sediment surface and are located well below the estimated bottom of the sheetpile wall. In contrast, the elevated concentrations (163 mg/kg) in boring ASB-5 are restricted to the organic silt and are well below 10 mg/kg with depth. In the remaining A-A' sediment borings, all of the concentrations are less than 10 mg/kg, but higher concentrations are generally confined to the organic silt (Figure 3-1). One notable exception is a concentration of 7.85 mg/kg in the peat layer in boring ASB-7.

Cross section B-B' is located approximately 50 to 100 ft east of cross section A-A' (Figure 2-2). As in A-A', the general groundwater flow in B-B' is believed to be perpendicular to the page, with some influence on hydrology from the north to south trending groundwater hydrology of the Acushnet River valley. The sediments along B-B' have been dredged previously, and up to 6 ft of sediment has been removed since 1991. The sediment samples analyzed from boring ASB-8 had considerably elevated concentrations of PCBs (Figure 3-3). Boring ASB-8 is on a similar flow path as boring ASB-1 in cross section A-A'. Concentrations of PCBs in boring ASB-8 are as high as 3,280 mg/kg, and concentrations greater than 100 mg/kg were found as deep as 17 ft below the harbor bottom sediment surface at the time of drilling in July 2012 (Figure 3-3). No organic silt deposit was found in boring ASB-8, and the contamination is found in the lower marine and glacial outwash deposits (Figure 3-3). There is no case where PCB concentrations exceed 10 mg/kg in the glacial till or sediment overlying bedrock (Figure 3-3). For the remaining sediment borings in cross section B-B', the PCB concentrations are lower than in boring ASB-8 and the concentrations greater than 10 mg/kg were relegated to the marine deposits. Boring

ASB-14 has a maximum concentration of 650 mg/kg which decreases to less than 10 mg/kg in outwash deposits at 4 ft below the sediment surface. Boring ASB-11 has no concentrations above 10 mg/kg, and boring ASB-9 has one concentration of 1.05 mg/kg in the organic silt layer (Figure 3-3). Boring ASB-18 is located on a similar flow-path as ASB-3 and has a maximum concentration of 1,700 mg/kg in the marine deposits 3 ft below the sediment surface and decreases to less than 10 mg/kg in the outwash deposits 5 ft below the sediment surface (Figure 3-3). Boring ASB-10 has a concentration of 59 mg/kg in the black organic silt layer and a concentration of 2.25 mg/kg in the marine deposits below (Figure 3-3). Boring ASB-22 was a short core that included only marine deposits and had a maximum concentration of 8.2 mg/kg at 1 ft below sediment surface that decrease below (Figure 3-3). Boring ASB-24 was another short core that included only marine deposits. There is a maximum concentration of 35 mg/kg at 2 ft below surface that decreases to less than 10 mg/kg below (Figure 3-3). Boring ASB-25, the southernmost in B-B', is another short core that includes only marine deposits. The top sample has a PCB concentration of 210 mg/kg and was collected in organic silt material at 1 ft below surface. The remaining two samples decrease to to below 10 mg/kg at 5 ft below the sediment surface. All remaining PCB concentrations in this cross section are below 10 mg/kg. Results for 10 of the 21 nearshore borings in cross sections A-A' and B-B' along the Aerovox shoreline show that PCB concentrations in sediment down to bedrock are below the OU1 ROD target cleanup level of 10 ppm for Upper Harbor mudflats and subtidal areas (Figures 3-2 and 3-3).

Cross section C-C' is a west-east cross section south of the former Aerovox building that represents a contaminant transport pathway along the drainage swale from the south side of the location of the former Aerovox building into the harbor (Figure 1-2). Historically the drainage swale was described as unlined (Versar 1981). The cross section begins at soil boring B01B and includes all soil borings from the "B" series collected in 2013 and includes well boring MW-13 and UV-17. It extends through borings ASB-29, ASB-3, ASB-9, and ASB-35 in the harbor. The PCBs on the Aerovox Site show two areas of soil contamination (Figure 3-4). On the Aerovox Site, all of the borings along C-C' have detectable concentrations of PCBs with the exception of the furthest west location, B01B. Most of the PCB concentrations above 1 mg/kg are in the fill deposits with the exception of B02B and B03B where concentrations of 14.7 mg/kg and 3.19 mg/kg, respectively, are found in the outwash deposits approximately 8 to 10 ft below surface. The PCB concentration found in B06B of 146.4 mg/kg is located near a former loading bay of the former Aerovox building. A second area of contamination is found east of boring B07B with a maximum concentration of 1,000 mg/kg in B08B, and is found within the first 1 ft of fill. Three samples collected in the fill material range from 197.2 to 288 mg/kg in borings B09B and B10B. Boring UV-17 had the highest concentrations of PCBs found in cross section C-C'. Four samples collected between 5 ft and 9 ft had concentrations of PCBs ranging from 2,240 mg/kg to 5,131 mg/kg. All but one was located in a peat deposit. The peat sample at 10 ft had a concentration of 36.90 mg/kg. This area of high concentrations is extended into the harbor with borings ASB-29 and ASB-3 (described previously in cross section A-A'). Maximum concentrations of 1,900 mg/kg in ASB-29 and 3,580 mg/kg in ASB-3 are related to the concentrations found in the peat deposits in UV-17 and have extended beyond the reach of the sheet-pile wall in that location (Figures 3-2 and 3-5). In addition, PCB contamination has extended into the glacial till at ASB-29 with a concentration of 16.3 mg/kg, the highest found in the till for all locations. PCB concentrations in ASB-9 are less than 1.05 mg/kg and show no relationship with any boring either on or off of the Aerovox Site. However, elevated concentrations in ASB-10 (Figure 3-2) with a maximum concentration of 1,700 mg/kg may well show a relationship between UV-17 and ASB-29/ASB-3 and indicate that contamination extends 80 ft east into the harbor sediments. Boring ASB-35 had a maximum concentration of 22 mg/kg and that was restricted to the top sample (0.5-1.0 ft) that was a dark marine deposit with all subsequent samples less than 10 mg/kg below. Cross section C-C’ shows a clear relationship between PCB contamination found on the Aerovox Site with contamination in the harbor sediments (Figure 3-2).

Cross section D-D’ characterizes the southern portion of the Aerovox Site (Figure 2-2). The cross section begins at B01C and includes all of the soil borings in the “C” series. It extends through boring ASB-5, boring ASB-10, and boring ASB-20 in the harbor (Figure 2-1). All of the Aerovox Site soil sample locations with PCB concentrations greater than 1 mg/kg are found within the fill material (Figure 3-6). The maximum concentration along this transect line is 299 mg/kg in boring B10C in the 0-2 ft sample and a concentration of 97.8 mg/kg located in the 3-5 ft sample. The concentrations then decrease below 1 mg/kg at 8 ft below the surface. This boring is the closest to the sheet pile wall and contamination here can be tied to ASB-5 with a concentration of 163 mg/kg in the marine deposits just east of the sheet pile wall (Figure 3-2). Borings ASB-5 and ASB-10 are described in cross sections A-A’ and B-B’ and may show a relationship between contamination on the Aerovox Site with the harbor sediments. Boring ASB-20 is located farther to the east and has a maximum concentration of 20 mg/kg in the surface sample, is 10 mg/kg at 2 ft into the marine deposits and drops to 0.0335 mg/kg in the glacial outwash at 4 ft. It is noted that a storm sewer outfall is located on the shoreline in proximity to boring ASB-5.

Cross Section E-E’ traverses west to east along the northern side of the former Aerovox building, parallel to the former plant’s northern drainage trench (Figure 2-2). The cross section begins at MW-5 and runs through two well borings and three MIP borings. The cross section continues into the harbor through ASB-17, ASB-1, ASB-8, ASB-15, and ASB34 (Figure 2-2). On the Aerovox Site, the highest historical concentration of PCBs along this transect was found closest to the harbor in the fill material (Figure 3-7). Slightly elevated concentrations of PCBs are found in two upgradient locations (MW-18 and MIP-43) with surface concentrations of 13.61 and 23.8 mg/kg, respectively, in the fill. Concentrations at these locations decrease to less than 1 mg/kg below 2 ft below the surface. Borings MIP-54 and MIP-53 have the highest concentrations of PCBs of any sample from the Aerovox Site. MIP-54 has a concentration of 30,500 mg/kg in the 3-5 ft sample and 5,460 mg/kg in the sample collected 7 ft below the soil surface. Concentrations in MIP-54 decrease below 1 mg/kg 14 ft below the soil surface in the glacial outwash, but show a concentration of 7.12 mg/kg in the glacial till just above bedrock. Boring MIP-53, closer to the shoreline, has a maximum concentration of 20,500 mg/kg in the 3-5 ft sample and 214 mg/kg in the 10-12 ft sample within the glacial outwash, with concentrations decreasing to less than 1 mg/kg below 12 ft within the glacial outwash. Cross section E-E’ is different from the other west-to-east cross sections because it does not intersect the sheet-pile wall. The entire cross section is north of the sheet pile wall and therefore fill material and sediments are directly in contact with the harbor. This relationship is evident in the high concentrations found in borings ASB-17 (2,700 mg/kg), ASB-1 (8,350 mg/kg), and ASB-8 (3,790 mg/kg) described in cross sections A-A' and B-B'. There also seems to be a continuation of this contamination with concentrations of 2,000 mg/kg in ASB-15, located 60 ft east of ASB-8. This boring has elevated concentrations of PCBs in the marine sediments ranging from 2,000 to 21.8 mg/kg. There is also PCB detected in the outwash deposits with a maximum of 823 mg/kg. Concentrations fall to below 10 mg/kg at 15 ft below the sediment surface. A boring 50 ft east of ASB-15, ASB-34, has a surface sample with PCB concentration of 280 mg/kg and less than 10 mg/kg 2 ft below. Boring ASB-34 may or may not be related, but PCB contamination appears to originate on the Aerovox Site terminating in the harbor sediments in cross section E-E' (Figure 3-2).

Cross section F-F' traverses west to east between cross sections C-C' and E-E' (Figure 2-2). The cross section runs from soil boring B01A and through the "A" series soil borings and includes MIP-55S and MIP-46. In the harbor, the cross section runs through ASB-2, ASB-11, and ASB-33. Borings ASB-2 and ASB-11 were described in previous cross sections (Figures 3-1 and 3-3). Cross section F-F' shows two major areas of contamination on the Aerovox Site; one in glacial outwash deposits in B02A at 4-6 ft below the surface with a PCB concentration of 335 mg/kg, and the second closer to the sheet pile wall in B10A, MIP-55S, and MIP-46. The contaminants are found in the fill material at a depth of 3 to 7 ft below the sediment surface and immediately above a peat layer with PCB concentrations ranging from 213 to 2,980 mg/kg. Boring MIP-46 also shows deeper contamination with a PCB concentration of 284 mg/kg in the outwash deposits at 20 to 22 ft below the surface. These concentrations are not observed in the harbor sediments along this cross section in ASB-2, ASB-11, or ASB-33. The stratigraphic sequence is a typical marine over glacial outwash over glacial till over bedrock sequence typically found in the dredged areas of the harbor. PCBs in the harbor cross section east of the sheet pile wall are restricted to one sample in boring ASB-2 with a concentration of 2.74 mg/kg in the black organic silt (Figure 3-8). No other sample in this cross section exceeded a 10 mg/kg concentration.

Cross section G-G' traverses west to east through two areas containing documented DNAPL (Figure 2-2). There are two locations with surficial contamination in this cross section. The surface sample of MP-11 has a PCB concentration of 5,540 mg/kg, but is relegated to the top two ft of fill deposits. The concentrations below 2 ft decrease drastically through the fill and into the outwash deposits (Figure 3-9). The second surficial area of contamination is found due west of the sheet pile wall in MIP-15 and MIP-47 with concentrations of 330 and 150 mg/kg, respectively, in the top 5 ft of fill material. This area and its proximity to the sheet pile wall could explain the elevated concentrations of PCBs in the surface sample of ASB-28 (240 mg/kg) (Figure 3-9). An area containing DNAPL was identified by presence of free product in well MW-15 near the sheet pile wall in the northeast corner of the Aerovox property (Figure 2-2) (AECOM 2015). Soil samples collected in borings MIP-48, MW-15, MIP-15, and MIP-47 have maximum concentrations of PCBs ranging up to 9,180 mg/kg between 23 ft and 30 ft below the surface in the outwash deposits above bedrock (Figure 3-9). This DNAPL is present and may be perching on the bedrock surface. However, based on the analytical data from harbor boring ASB-28, there is no indication this PCB-rich DNAPL has migrated past the sheet pile wall into the harbor sediments (Figure 3-5). Boring ASB-16 also showed signs of DNAPL in the harbor sediments. Concentrations of PCBs were found in this boring from the surface (4,400 mg/kg) into the glacial till above bedrock (8.4 mg/kg). Boring logs indicate presence of a DNAPL sheen between 5.5 ft and 9 ft below the sediment surface. A "pool" of DNAPL was noted between 7.4 and 7.8 ft below the surface. Coincidently, the PCB concentration of the 7.5 to 8.0 ft sample was 27,100 mg/kg (Figure 3-9). This area of contamination appears to be isolated in the harbor with the nearby ASB-15 the only boring that may be related to this pool of DNAPL due to the elevated concentrations in that boring. Borings ASB-15 and ASB-16 are located in a "no dredge" zone where VOC vapors are considered too high to dredge under normal conditions. ASB-16 is approximately 150 ft east of the sheet pile wall. Boring ASB-32 is located approximately 40 ft east of ASB-16 and has much lower PCB concentrations. The PCB concentrations are elevated slightly in the surface at 48.1 mg/kg, which is located in organic silt material. Concentrations decrease drastically to non-detect in the underlying glacial outwash.

## 3.3 VOCs

Total VOCs were determined using a sum of volatile organic compounds detected in samples from the borings and were different based on those reported (Jacobs 2013; AECOM 2015; Battelle 2016). Those compounds included:

1,1,1-Trichloroethane (AECOM 2015)

1,1,2-Trichloroethane (AECOM 2015)

1,1-Dichloroethane (AECOM 2015)

1,1-Dichloroethene (Jacobs 2013; AECOM 2015)

1,2,3-Trichlorobenzene (Jacobs 2013)

1,2,4-Trichlorobenzene (Jacobs 2013; AECOM 2015)

1,2-Dichlorobenzene (Jacobs 2013; AECOM 2015)

1,3-Dichlorobenzene (Jacobs 2013; AECOM 2015)

1,4-Dichlorobenzene (Jacobs 2013; AECOM 2015)

Carbon Tetrachloride (AECOM 2015)

Chlorobenzene (Jacobs 2013; AECOM 2015)

Chloroform (AECOM 2015)

cis-1,2-DCE (Jacobs 2013; AECOM 2015; Battelle 2016)

Tetrachloroethene (Jacobs 2013; AECOM 2015)

trans-1,2-Dichloroethene (Jacobs 2013; AECOM 2015)

TCE (Jacobs 2013; AECOM 2015; Battelle 2016)

Vinyl chloride (Jacobs 2013; AECOM 2015; Battelle 2016)

Cross section A-A' contains borings with the highest concentrations of VOCs of all of the cross sections 5rom the 2012 near-shore boring program (Figure 2-1). Boring ASB-3 has the highest concentrations of any boring with a maximum total concentration of 27,700 mg/kg (Figure 3-10). All of the concentrations greater than 1,000 mg/kg were located in the black organic silt of borings ASB-2, ASB-3 and ASB-29 (Figure 3-10). Concentrations greater than 10 mg/kg are found in borings ASB-17, ASB-1, ASB-28, ASB-2, ASB-12, ASB-3, ASB-29, ASB-4 and ASB-6 with the deepest sample with a concentration greater than 10 mg/kg located approximately at 13 ft below the sediment surface in ASB-17 (Figure 3-10). The elevated VOC concentrations in boring ASB-3 are coincident with the highest PCB concentrations in cross section A-A' (Figure 3-1). However, the overall distribution of VOC concentrations varied from that of the PCBs along A-A', with elevated VOCs found in the upper portions of boring ASB-2 and ASB-12. Also, while elevated, the concentrations of VOCs in ASB-1 and ASB-17 are relatively lower than PCB concentrations in those borings. In addition, lower concentrations of VOCs (consisting almost entirely of TCE) were also found in the deeper glacial outwash and till samples of several borings (Figure 3-10).

Similar to cross section A-A', the highest VOC concentrations along cross section B-B' were coincident with the highest PCB concentrations with a maximum VOC concentration of 1,550 mg/kg found in boring ASB-8 at a depth of 7.5 ft below the sediment surface (Figure 3-11). Also similar to cross section A-A', the overall distribution of VOC concentrations varied somewhat from that of PCBs along B-B' in that elevated concentrations of VOCs in ASB-9 did not match PCB concentrations and the elevated PCB concentrations in ASB-18 were not mirrored in the VOC concentrations (Figures 3-3 and 3-11). Elevated concentrations of VOCs in the surface sample of ASB-9 could be related to the highest concentrations observed in ASB-3 aligned with the southern ditch outlet from Aerovox. VOCs were still detected in the deeper portions of the borings along B-B', but total concentrations were below 1 mg/kg.

The borings in cross section C-C' shows one major and one minor area of VOC contamination. The first is related to boring UV-17 in the fill and peat material adjacent to the sheet pile wall (Figure 3-12). VOC concentrations range from 920 to 18,000 mg/kg in this unit to a depth of 10 ft below the surface and are likely related to contamination in the surface sediment of ASB-3 with concentrations from 13,500 to 27,700 mg/kg to a depth of 2 ft below the surface (Figure 3-13). The VOCs in UV-17 and ASB-3 are primarily TCE with lesser quantities of cis-1,2-DCE, and vinyl chloride. This location may be coincident with the bottom of a 13 ft sheet pile wall. This area of contamination may extend to ASB-9 with a VOC concentration of 1,040 mg/kg in the surface sample. Concentrations of VOCs fall below 10 mg/kg in ASB-35 located 60 ft to the east. A second area of contamination is found in B04B on the Aerovox Site with a shallow sample with a VOC concentration of 520 mg/kg. There are no other samples nearby with a concentration greater than 10 mg/kg (Figure 3-12).

There is little VOC contamination evident in southern cross section D-D' ( Figure 3-14). The highest VOC concentration is located in ASB-10 at 642 mg/kg described in cross section B-B'. There is some contamination in ASB-20 located 50 ft to the east with a VOC concentration of 150 mg/kg approximately 2 ft below the sediment surface (Figure 3-14). All of the VOC concentrations in this cross section on the Aerovox property are less than 10 mg/kg with the highest concentration in B05C of 2.4 mg/kg at 23 ft below the surface in the outwash deposits (Figure 3-14). There is no relationship evident between VOC contamination on site compared within the harbor sediments in cross section D-D'.

Cross section E-E' does not exhibit the degree of VOC contamination that was evident in the PCB concentrations (Figure 3-15). There is a significant area of contamination evident in ASB-8 that was described in the previous B-B' cross section description (Figure 3-3). VOCs are also found in ASB-15 approximately 50 ft to the east. It has concentrations ranging up to 980 mg/kg to a depth of 7 ft below the surface. Boring ASB-34 also has some elevated concentrations with up to 94 mg/kg at 4 ft below the surface approximately 90 ft east of ASB-8 (Figure 3-15). There are lower VOC concentrations on the Aerovox site itself with a maximum concentration of 95 mg/kg in MIP-54 at 7 ft below the surface. This contamination may be related to a 200 mg/kg concentration in the harbor boring ASB-17 at 6 ft below the surface (Figure 3-15). The VOC concentrations in E-E' show a more disconnected relationship between the Aerovox Site and the sediments in the harbor.

Cross section F-F' shows little VOC contamination not previously described (Figure 3-16). The highest concentrations are found in the harbor sediments of ASB-2 with a maximum of 2,450 mg/kg at 2 ft below the surface. The PCB contaminants in the Aerovox samples are not reflected in the VOC distribution as there is no concentration exceeding 4.9 mg/kg on the Aerovox property in this cross section (Figure 3-16). There is a lesser area of contamination in ASB-33, approximately 170 ft east of ASB-2 that has several samples that exceed 10 mg/kg (25-53 mg/kg) to a depth of 5 ft below the surface. This area does not seem to be connected to other areas of known contamination (Figure 3-13).

The VOC contamination in cross section G-G' is a reflection of the PCB contamination (Figure 3-9, 3-17) with the exception that the distribution of VOCs is more vertically confined. There is low level VOCs in the upgradient site with a maximum concentration of 66 mg/kg in MIP-11, but it is less compared to other areas with high concentrations. A second area of contamination is in ASB-16, located about 130 ft east of ASB-28, and has a maximum concentration of 1,100 mg/kg in the surface and concentrations as high as 730 mg/kg to a depth of 8 ft below the surface (Figures 3-17 and 3-18). This boring had the highest PCB concentration in the Harbor sediments and it does not show any relationship with any other boring around it in terms of concentrations and may represent an isolated depositional event. The most significant area of contamination is found at depth, above bedrock and below the sheet pile wall on the Aerovox Site. The area of contamination is smaller than the area of PCB contamination in the same cross section (Figure 3-9 and 3-17). Concentrations above 1,000 mg/kg are found in borings MIP-48, MW-15 and MIP-15 and range from 1,600 to 5,800 mg/kg at depths of 23 to 30 ft below the soil surface. Monitoring well MW-15 has been used to remove DNAPL since its discovery in 2014 (AECOM 2015). The VOC contamination here is primarily TCE with lesser amounts of tetrachloroethene. It is located below the maximum extent of the sheet pile wall and could migrate into the harbor. However, results from ASB-28 show that this VOC contamination has not yet moved across the Aerovox Site-harbor boundary as is also reflected in the PCB distribution although there are no samples between 8 and 16 ft below the sediment surface (Figure 3-17). To date, this area of contamination appears isolated, but unrestricted by any barrier that would impede its transport into the sediments under the harbor.

# 4.0 Summary

The percentage level VOC concentrations and near percentage level PCB concentrations detected in some of the nearshore borings indicate residual contamination likely exists as a separate DNAPL phase within the shallow river system. Potential transport mechanisms that could have resulted in this contaminant distribution beyond the Aerovox Site boundary include: (1) direct release of separate phase product from the plant's two drainage trenches to the shoreline during the operation of the Aerovox Site; (2) release/transport of separate phase product into the subsurface storm water drainage system with release to underlying soils and subsequent discharge to the harbor; (3) migration of separate phase product from the Aerovox Site prior to the installation of the sheetpile containment wall; and (4) migration of separate phase product that occurred after installation of the sheetpile wall, with transport beneath the wall or through gaps within the wall.

As part of the Massachusetts c. 21E assessment and response action at the Aerovox Site, through an ACO with the MassDEP, the nature and extent of contamination at the Aerovox Site has been investigated (Brown and Caldwell 2016). Various alternatives have been proposed including excavating on-site soils, *in situ* treatment of DNAPL, hydraulic containment and treatment of groundwater, and passive groundwater treatment. In the absence of remedial action, the contaminants on the Aerovox Site are likely to enter the harbor by erosion, gravimetric transport, mass wasting due to cap and sheet pile failure, macropore transport of non-aqueous phase products, and groundwater transport of dissolved phase products. Without any remedial action, it is possible that the on-site contaminants will continue to impact the harbor for many decades.

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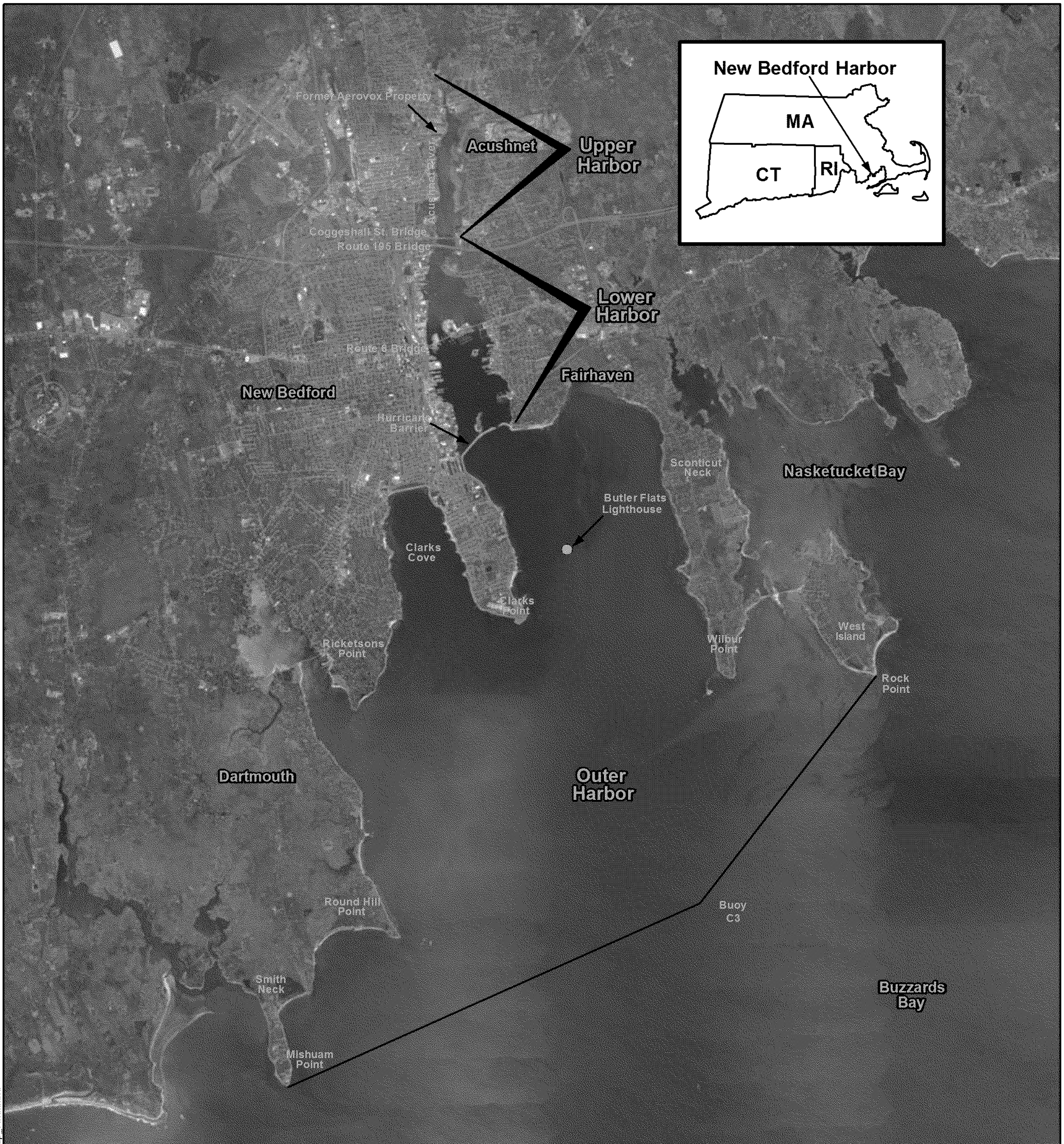
# Figures




**Legend**

N

0 2 Miles

1:100,000

*Basemap Reference: © 2009 Bing Maps Aerial*

JACOBS

## Site Location Map

New Bedford Harbor Superfund Site

NAME: jpiccuito Date: 2/26/2013

**Figure 1-1**

Path: Y:\NBH\Projects\35BG0708\20130225\ArcGIS\NBH_Site_Map_Final.mxd


Legend

JACOBS™

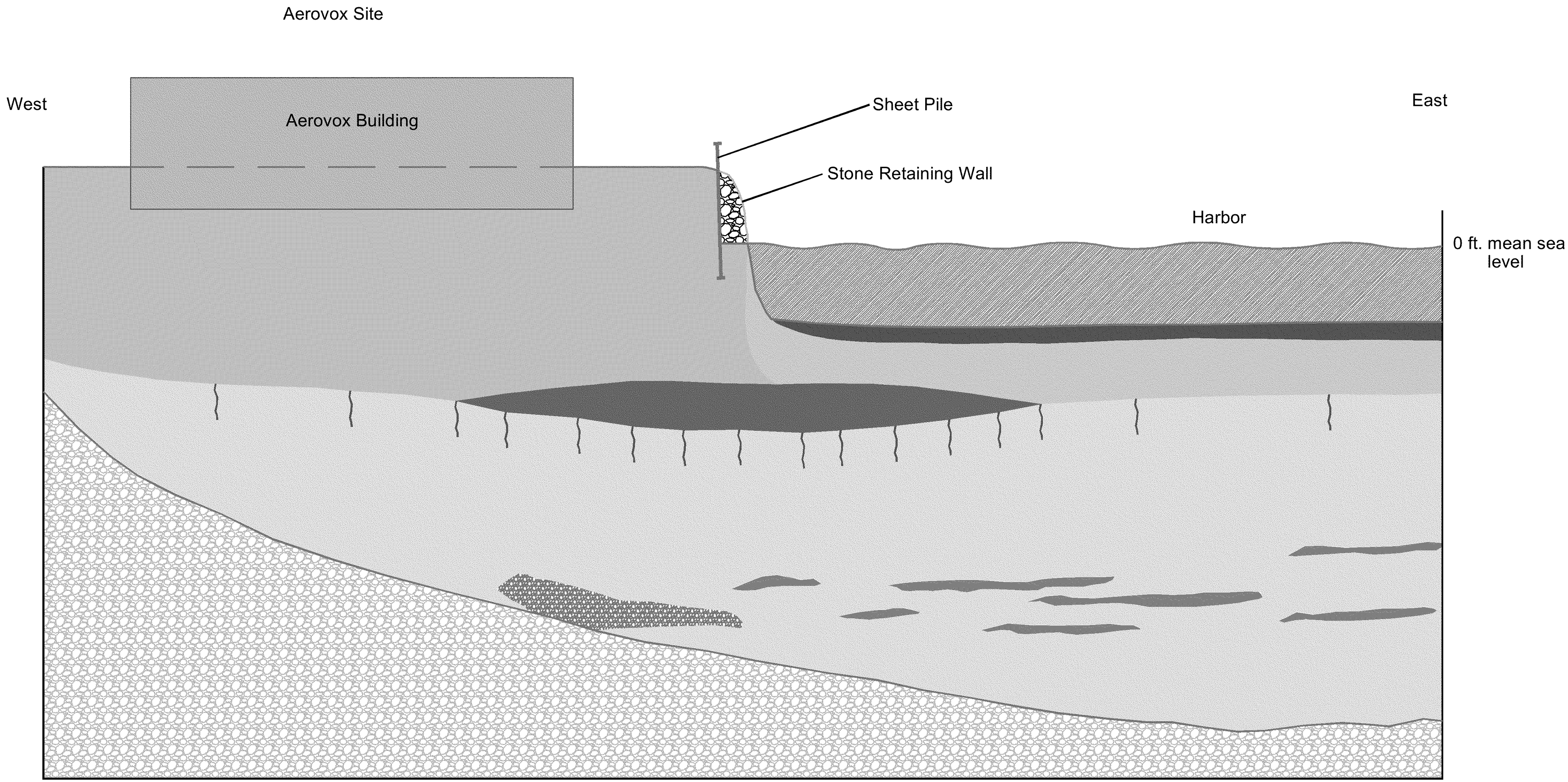
**Upper Harbor Showing Former Aerovox Property Location**

New Bedford Harbor Superfund Site

NAME: jpiccuito Date: 2/26/2013

**Figure 1-2**

Path: Y:\NBH\Projects\35BG0708\20130225\ArcGIS\Aerovox_NBH_Location_Map_Final.mxd




Legend

- Harbor Water
- OL
- Marine Deposits
- Glacial Outwash
- Glacio-Lacustrine Sediment
- Gravel
- Glacial Till
- Peat
- Fill
- Bedrock
- Paleosol

Not To Scale

JACOBS™

Aerovox Conceptual Cross Section

New Bedford Harbor Superfund Site

01/23/17 SC Aerovox_Conceptual_Section_20170116.dwg

Figure 2-1

last modified: 01/23/17 printed: 01/23/17 by sc Y:\NBH\Projects\35BG1001\20170116\AutoCAD\Aerovox_Conceptual_Section_20170116.dwg


Legend

Aerovox Boring Location

Aerovox Cross Section Location

Sheet Pile Location

Aerial Photography MASSGIS 2014

N

0 50 100

Feet

1:1,200

JACOBS

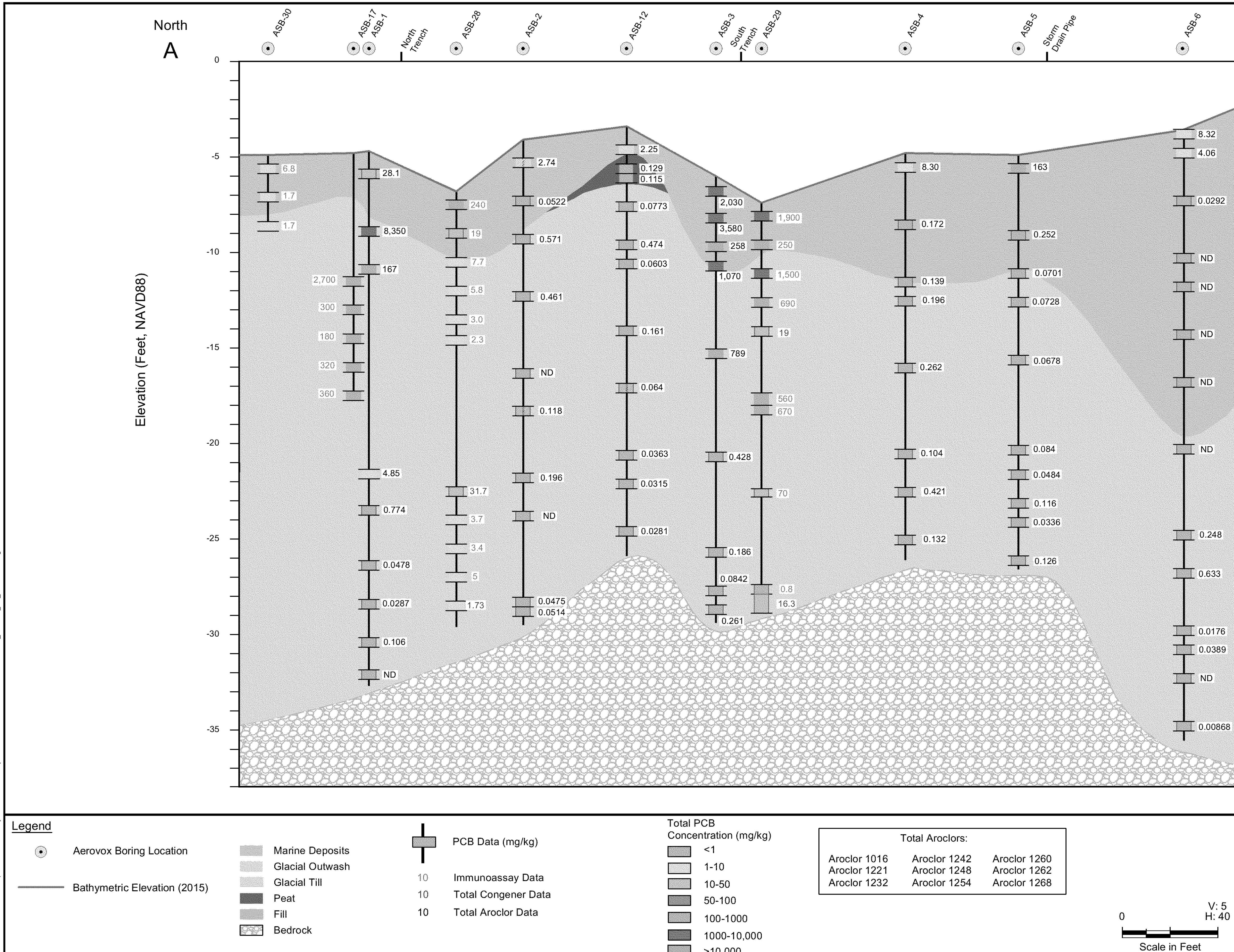
**Cross Section Locations for Former Aerovox Site Area**

New Bedford Harbor Superfund Site

NAME: gscott Date: 1/24/2017

**Figure 2-2**

Path: Y:\NBH\Projects\35BG1001\20170116\ArcGIS\Aerovox_Prelim_Bathy_Core_X_Sections_20170116.mxd



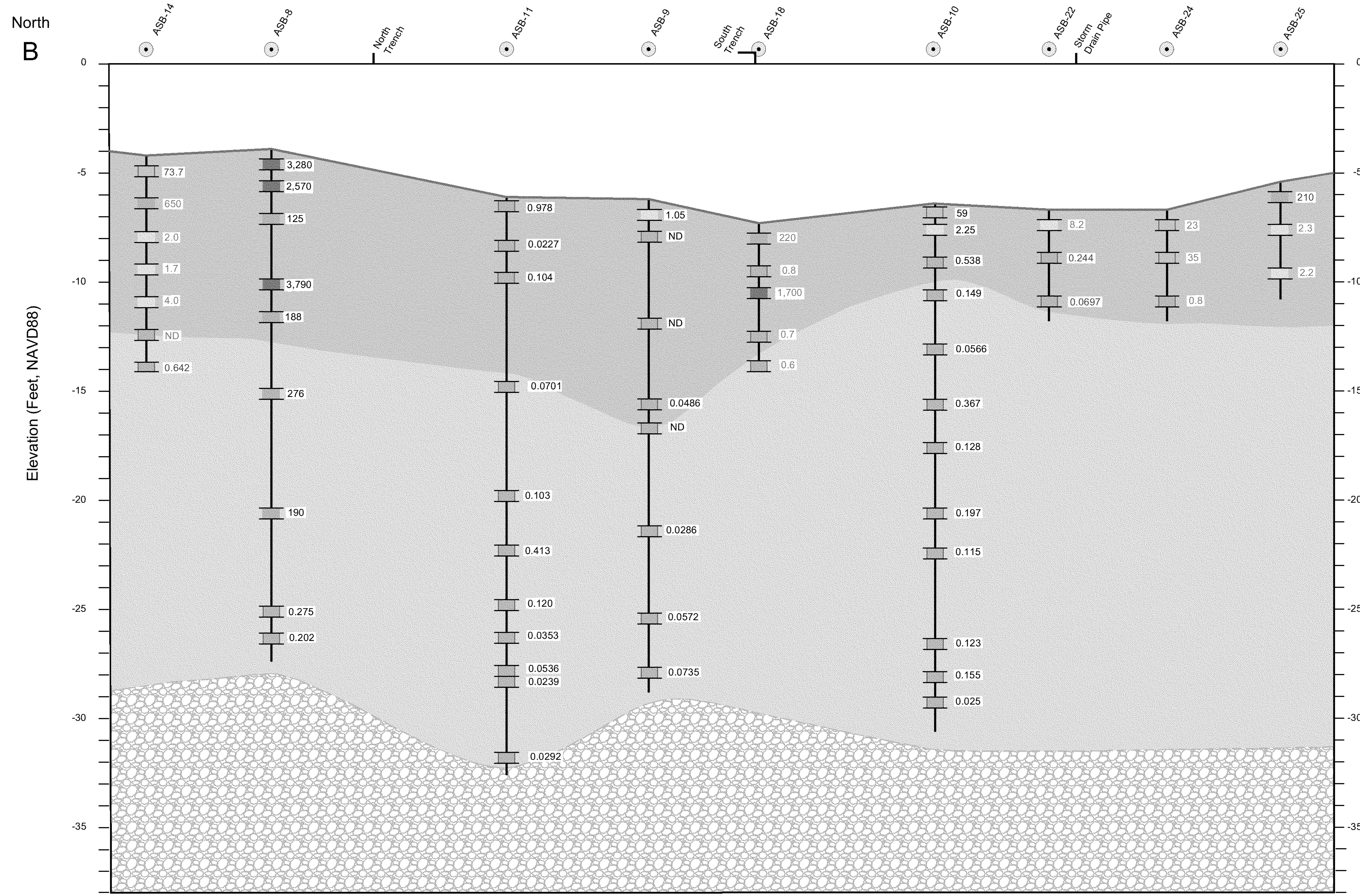

JACOBS™

Aerovox Cross Section A - A'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_AA_20170314.dwg

Figure 2-3




Legend

- Aerovox Boring Location
- Bathymetric Elevation (2015)
- Marine Deposits
- Glacial Outwash
- Glacial Till
- Bedrock

PCB Data (mg/kg)

10 Immunoassay Data
10 Total Congener Data
10 Total Aroclor Data

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total Aroclors:

| | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

0 V: 5 H: 40

Scale in Feet

JACOBS™

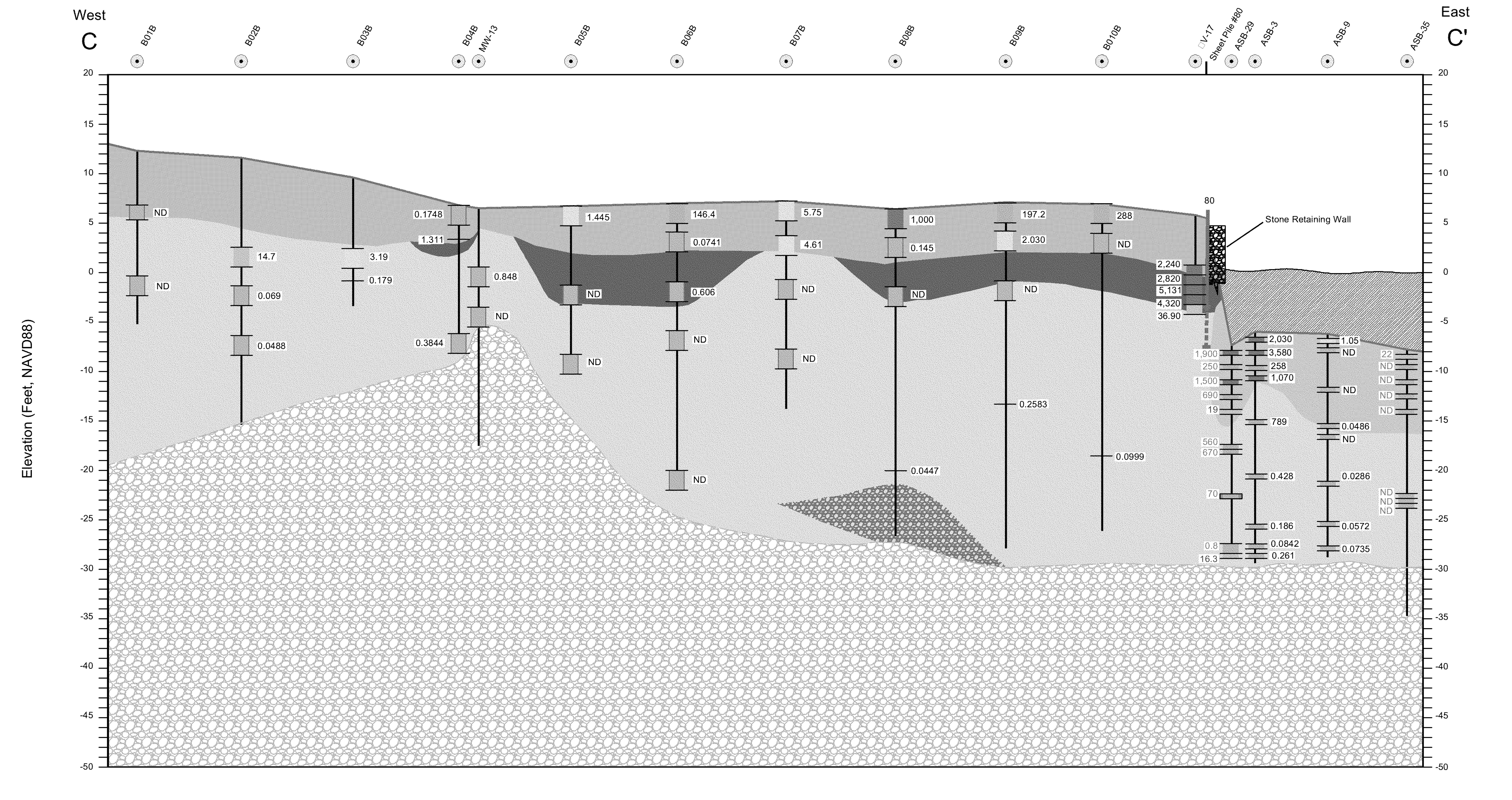
Aerovox Cross Section B - B'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_BB_20170314.dwg

Figure 2-4

last modified: 03/15/17 printed: 03/15/17 by sc Y:\NBH\Projects\35BG1001\20170314\AutoCAD\Litho_Aerovox_BB_20170314.dwg




Legend

- Aerovox Boring Location
- Bathymetric Elevation (2015)
- Harbor Water
- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Gravel
- Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

PCB Data (mg/kg)

10 Immunoassay Data

10 Total Congener Data

10 Total Aroclor Data

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

| Total Aroclors: | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

0

V: 10
H: 80

Scale in Feet

JACOBS™

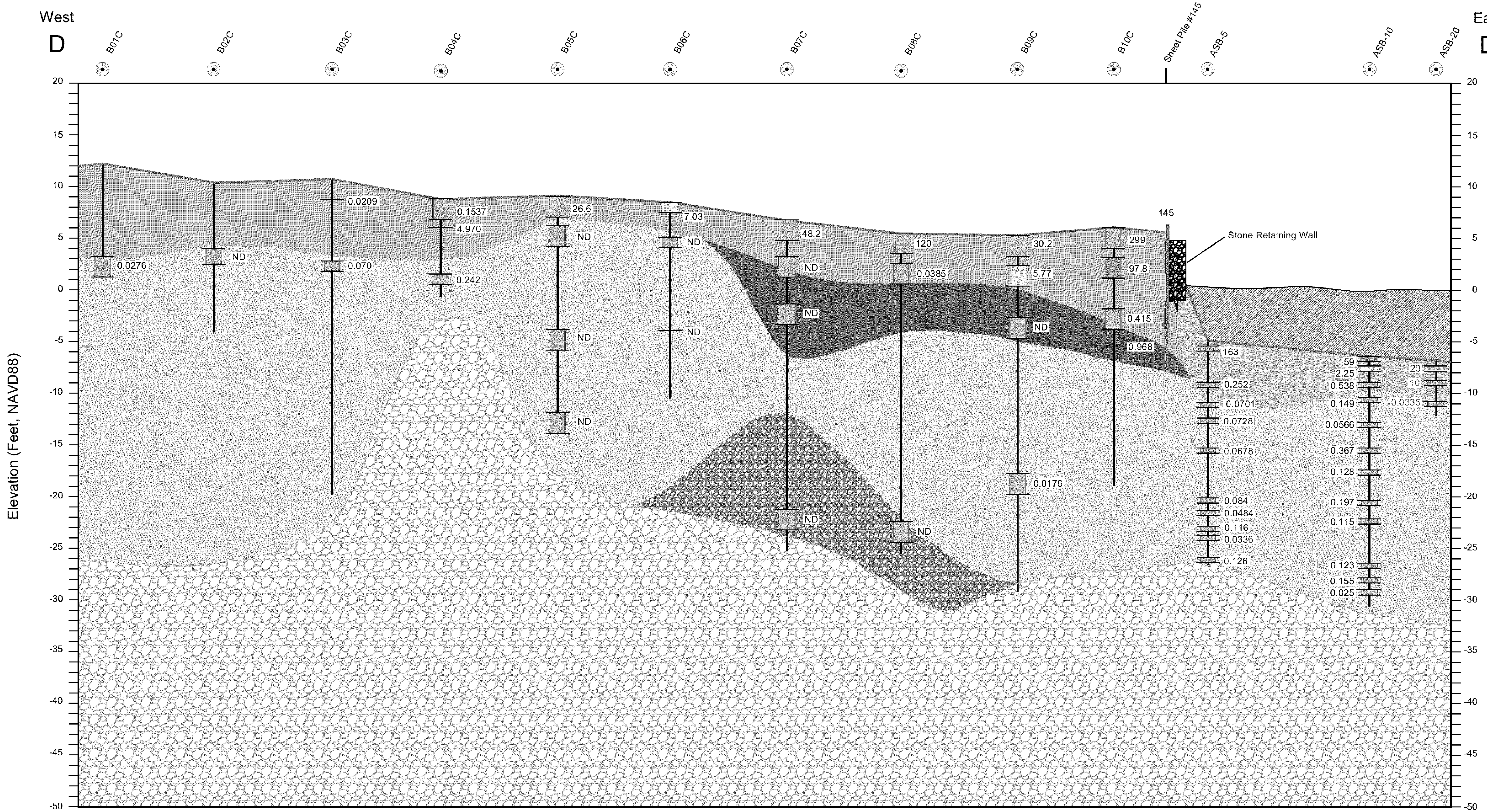
Aerovox Cross Section C - C'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_CC_20170314.dwg

Figure 2-5

last modified: 03/15/17 printed: 03/15/17 by sc Y:\NBH\Projects\35BG1001\20170314\AutoCAD\Litho_Aerovox_CC_20170314.dwg




Legend

Aerovox Boring Location

Bathymetric Elevation (2015)

Harbor Water
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Gravel
Bedrock

Sheetpile # 95
Sheetpile at 9 ft bgs
Sheetpile at 13 ft bgs
ft bgs = feet below ground surface

PCB Data (mg/kg)
10 Immunoassay Data
10 Total Congener Data
10 Total Aroclor Data

Total PCB Concentration (mg/kg)
<1
1-10
10-50
50-100
100-1000
1000-10,000
>10,000

| Total Aroclors: | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

V: 10
H: 80
0
Scale in Feet

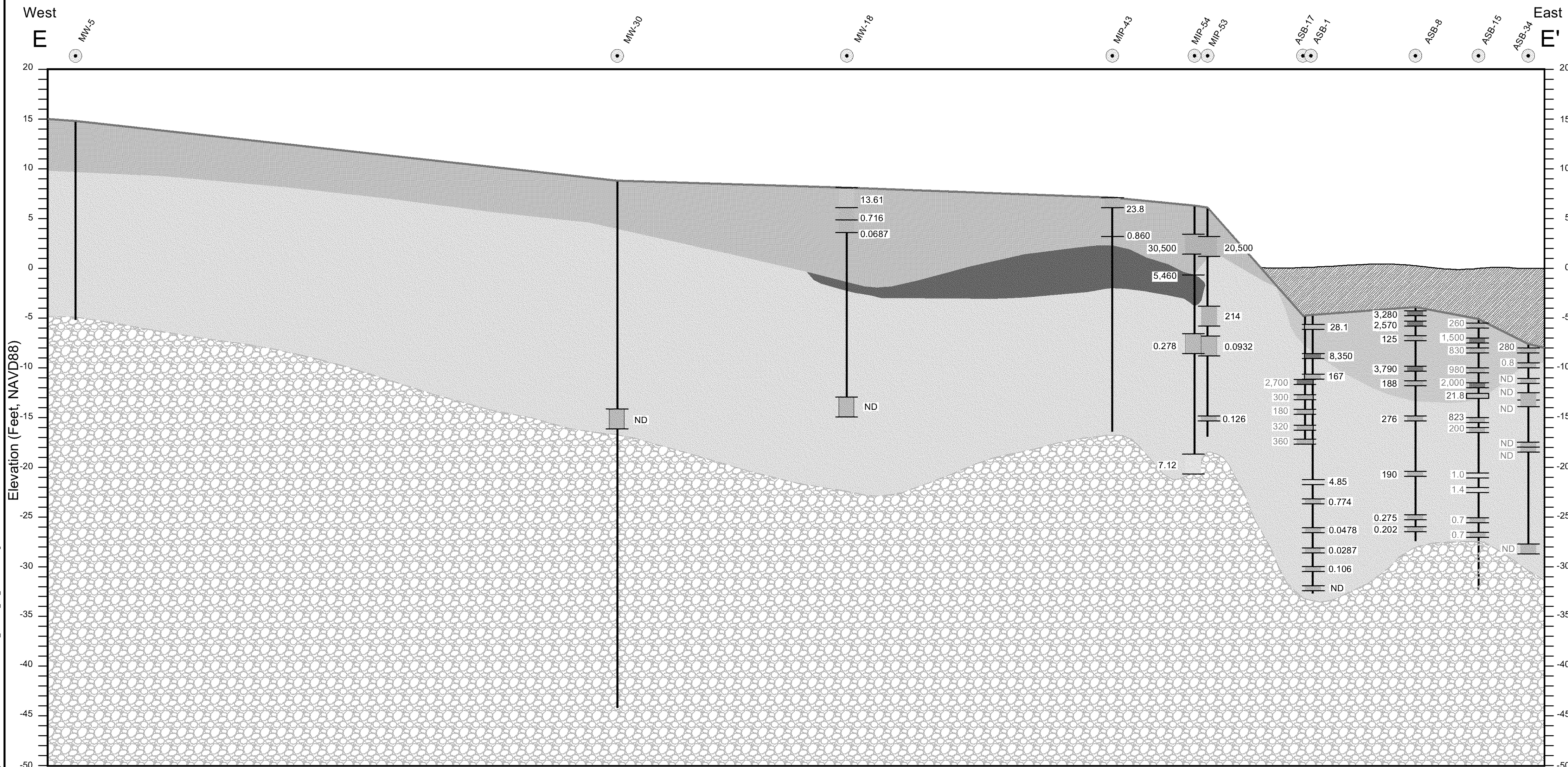
JACOBS™

Aerovox Cross Section D - D'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_DD_20170314.dwg

Figure 2-6




Legend

Aerovox Boring Location

Bathymetric Elevation (2015)

Harbor Water
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Gravel
Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

PCB Data (mg/kg)

10 Immunoassay Data
10 Total Congener Data
10 Total Aroclor Data

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total Aroclors:

| | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

V: 10
H: 80
0
Scale in Feet

JACOBS™

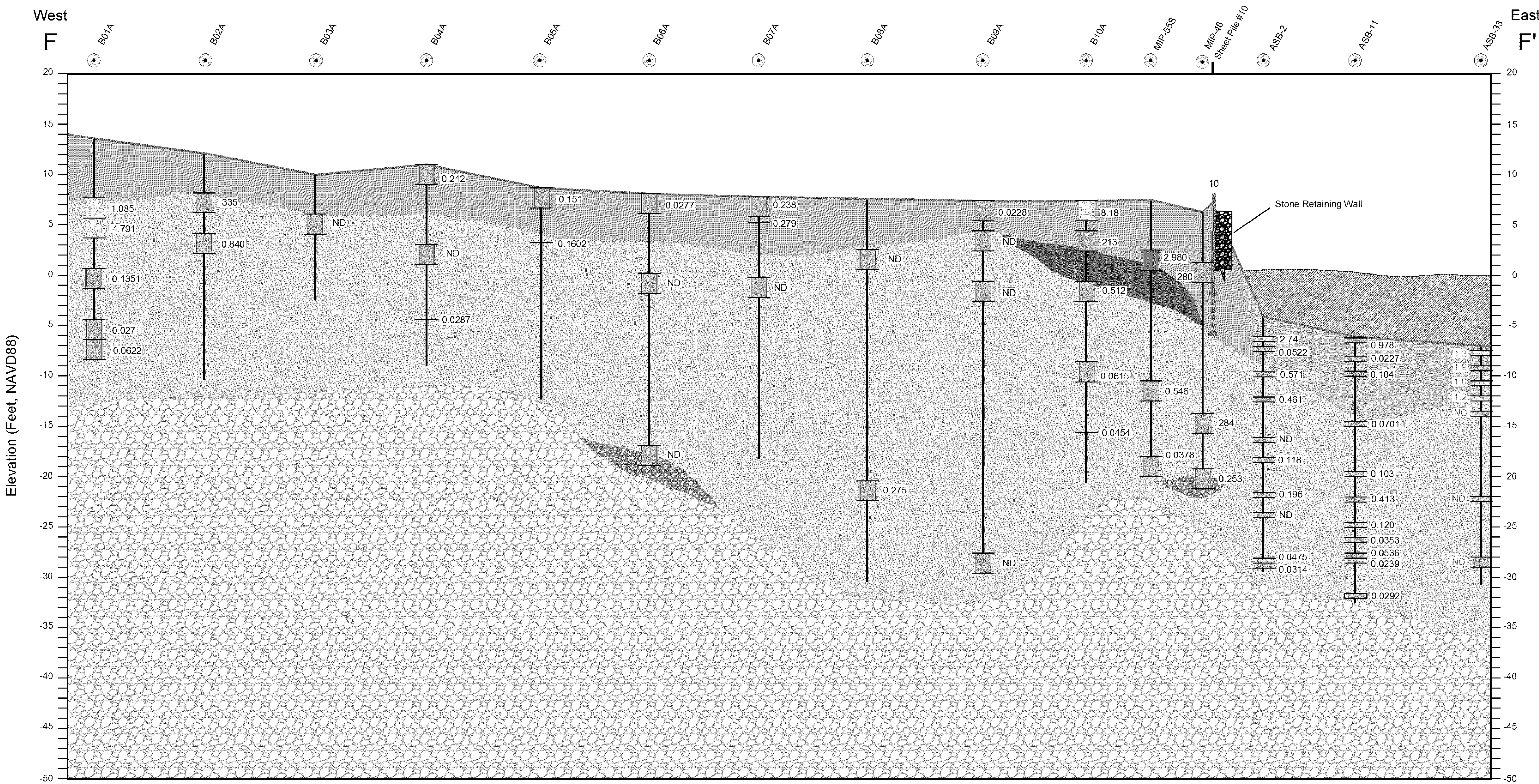
Aerovox Cross Section E - E'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_EE_20170314.dwg

Figure 2-7

last modified: 03/15/17 printed: 03/15/17 by sc Y:\NBH\Projects\35BG1001\20170314\AutoCAD\Litho_Aerovox_EE_20170314.dwg




Legend

- Aerovox Boring Location
- Bathymetric Elevation (2015)

- Harbor Water
- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Gravel
- Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

PCB Data (mg/kg)

10 Immunoassay Data

10 Total Congener Data

10 Total Aroclor Data

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total Aroclors:

| | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

0 V: 10 H: 80

Scale in Feet

JACOBS

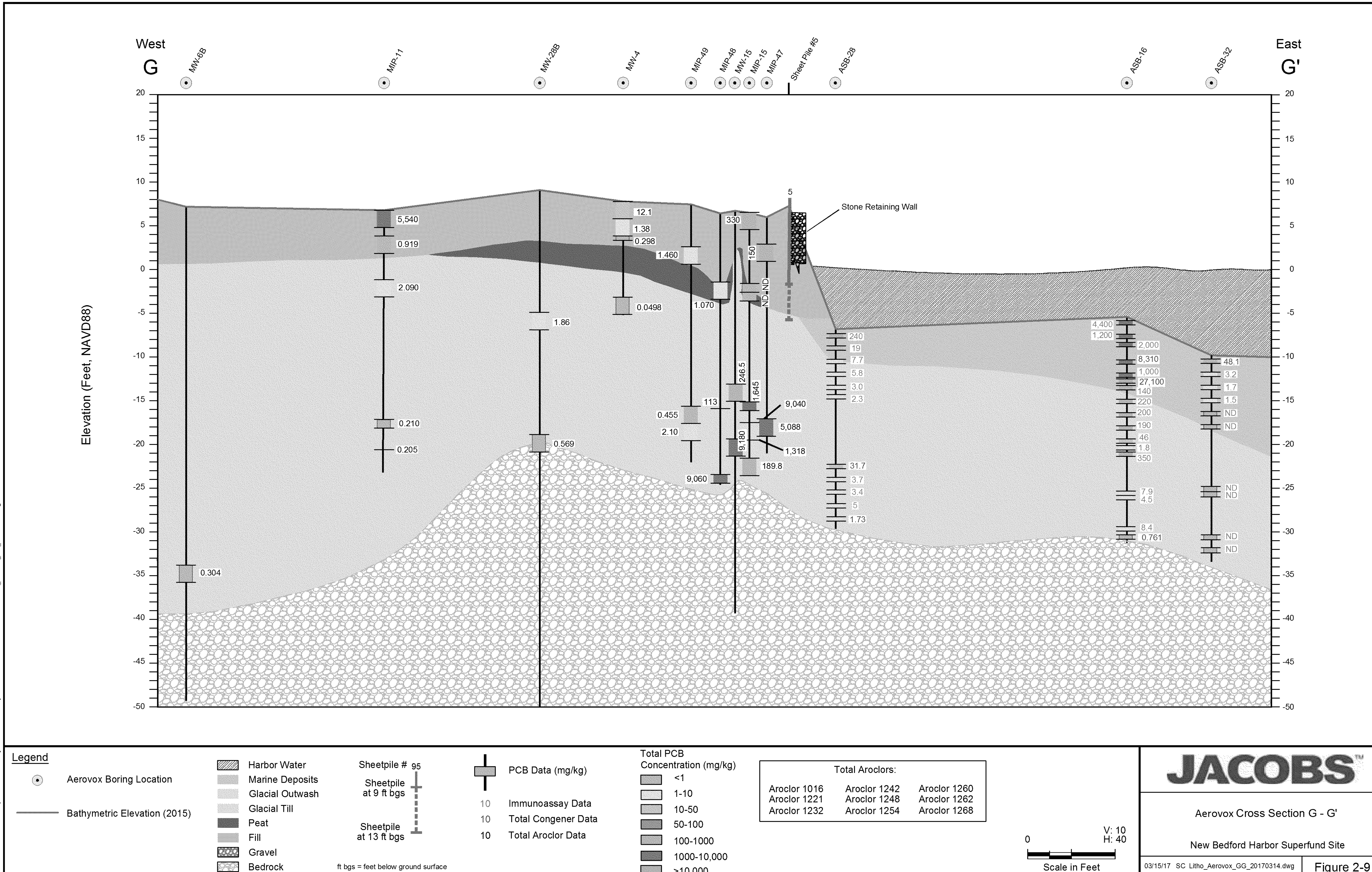
Aerovox Cross Section F - F'

New Bedford Harbor Superfund Site

03/15/17 SC Litho_Aerovox_FF_20170314.dwg

Figure 2-8

last modified: 03/15/17 printed: 03/15/17 by sc Y:\NBH\Projects\35BG1001\20170314\AutoCAD\Litho_Aerovox_FF_20170314.dwg



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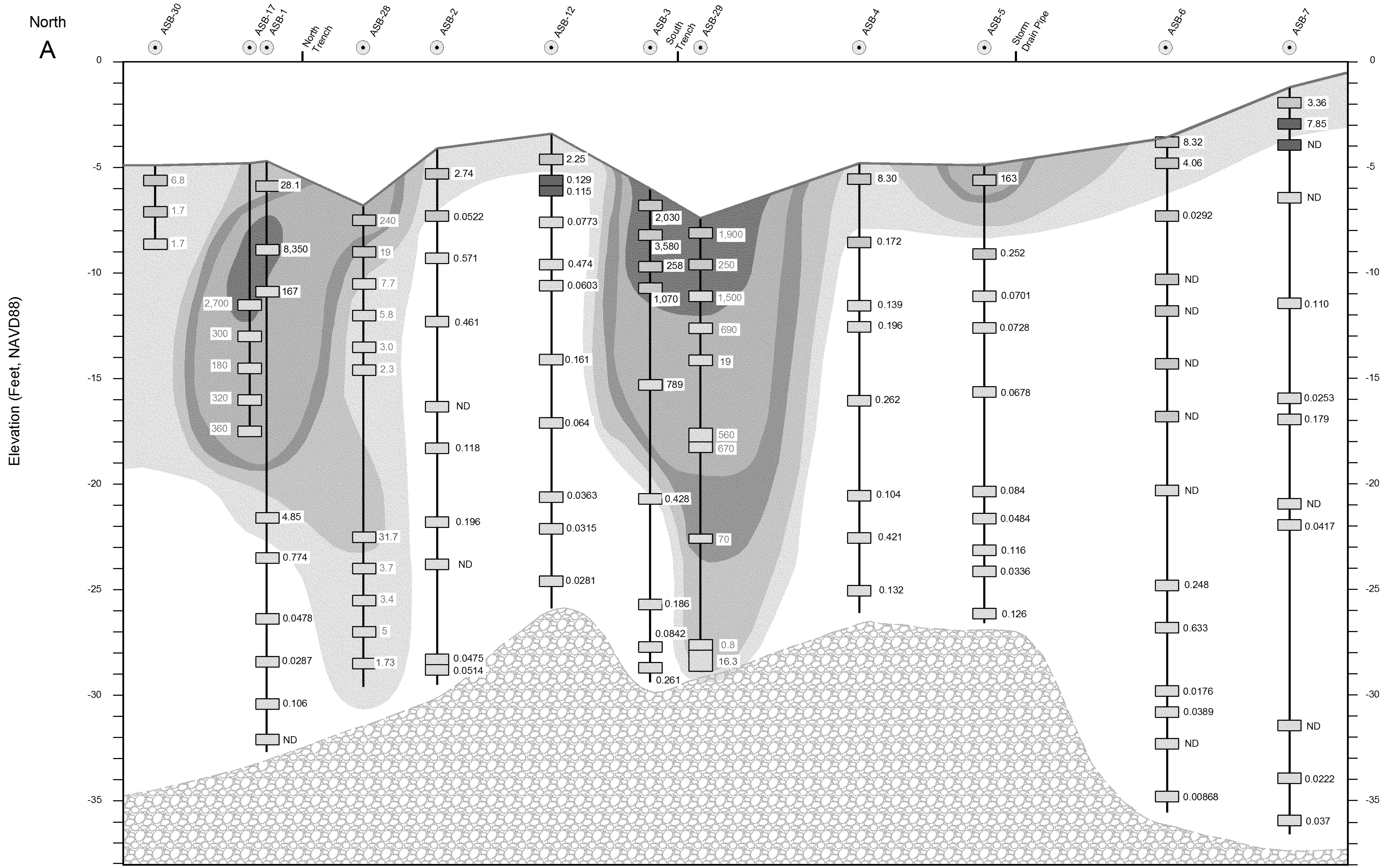



## Legend

| | |
|---|---|
| ⊙ | Aerovox Boring Location |
| — | Bathymetric Elevation (2015) |

- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Bedrock

PCB Data (mg/kg)

| | |
|---|---|
| 10 | Immunoassay Data |
| 10 | Total Congener Data |
| 10 | Total Aroclor Data |

ft bgs = feet below ground surface

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total Aroclors:

| | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

0 V: 5 H: 40

Scale in Feet

Cross Section A - A'

PCBs

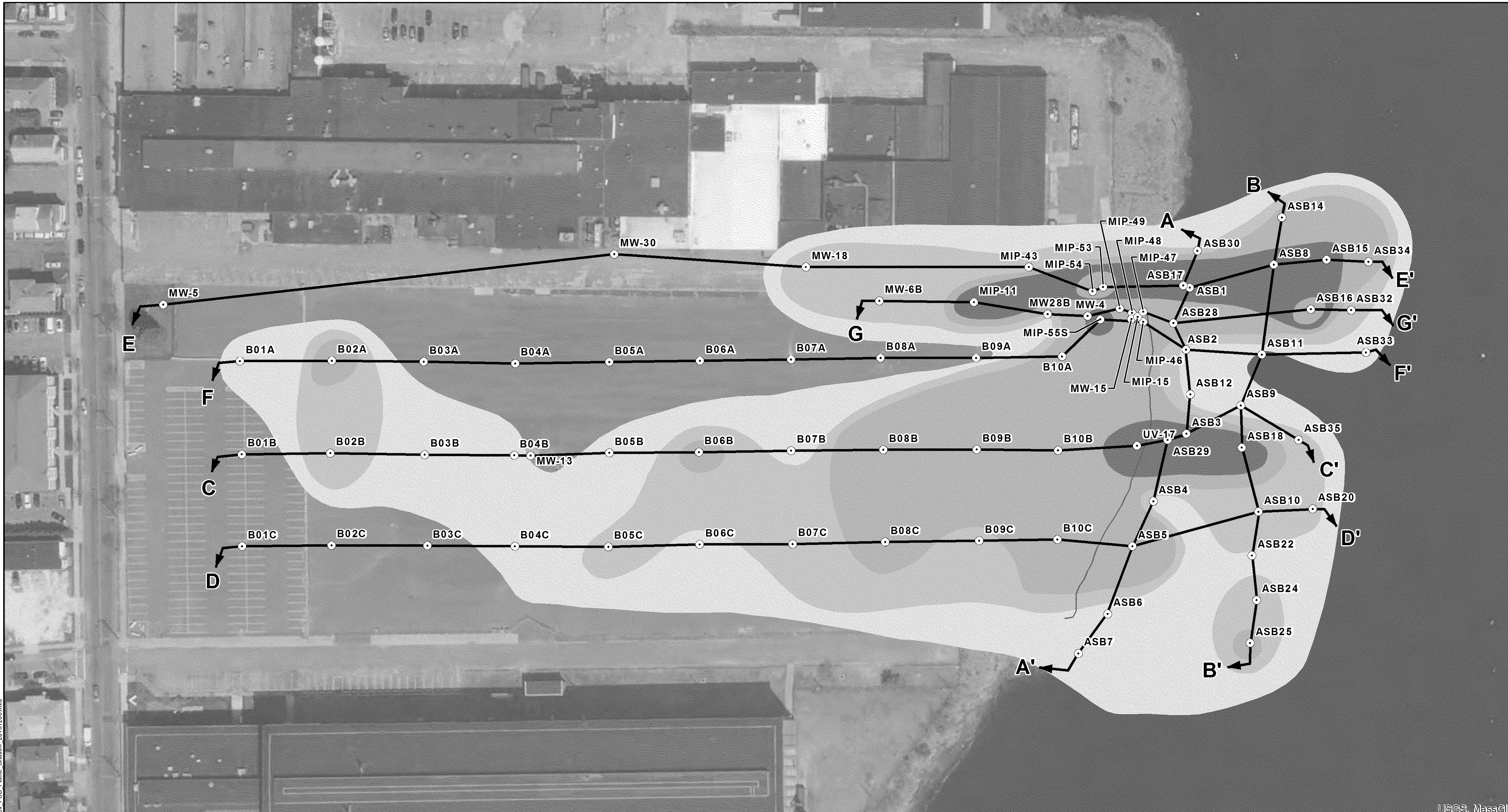
New Bedford Harbor Superfund Site

03/14/17 SC AX_AA_20170314_plume.dwg

Figure 3-1

Y:\NBH\Projects\35BG1001\20170314\AutoCAD\AX_AA_20170314_plume.dwg

last modified: 03/14/17 printed: 03/15/17 by sc




Legend

- Aerovox Boring Location
- Aerovox Cross Section Location
- Sheet Pile Location

**Total PCB**

**Concentration (mg/kg)**

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

**Shallow Soils/Sediments**
**Aerovox Site: 0-13 ft bgs**
**New Bedford Harbor: 0-7 ft bgs**

Aerial Photography MASSGIS 2014

0 50 100
Feet
1:1,200

JACOBS

**PCB Distribution for Former Aerovox Site Area Shallow Soils/Sediments**

New Bedford Harbor Superfund Site

Date: 1/24/2017

**Figure 3-2**

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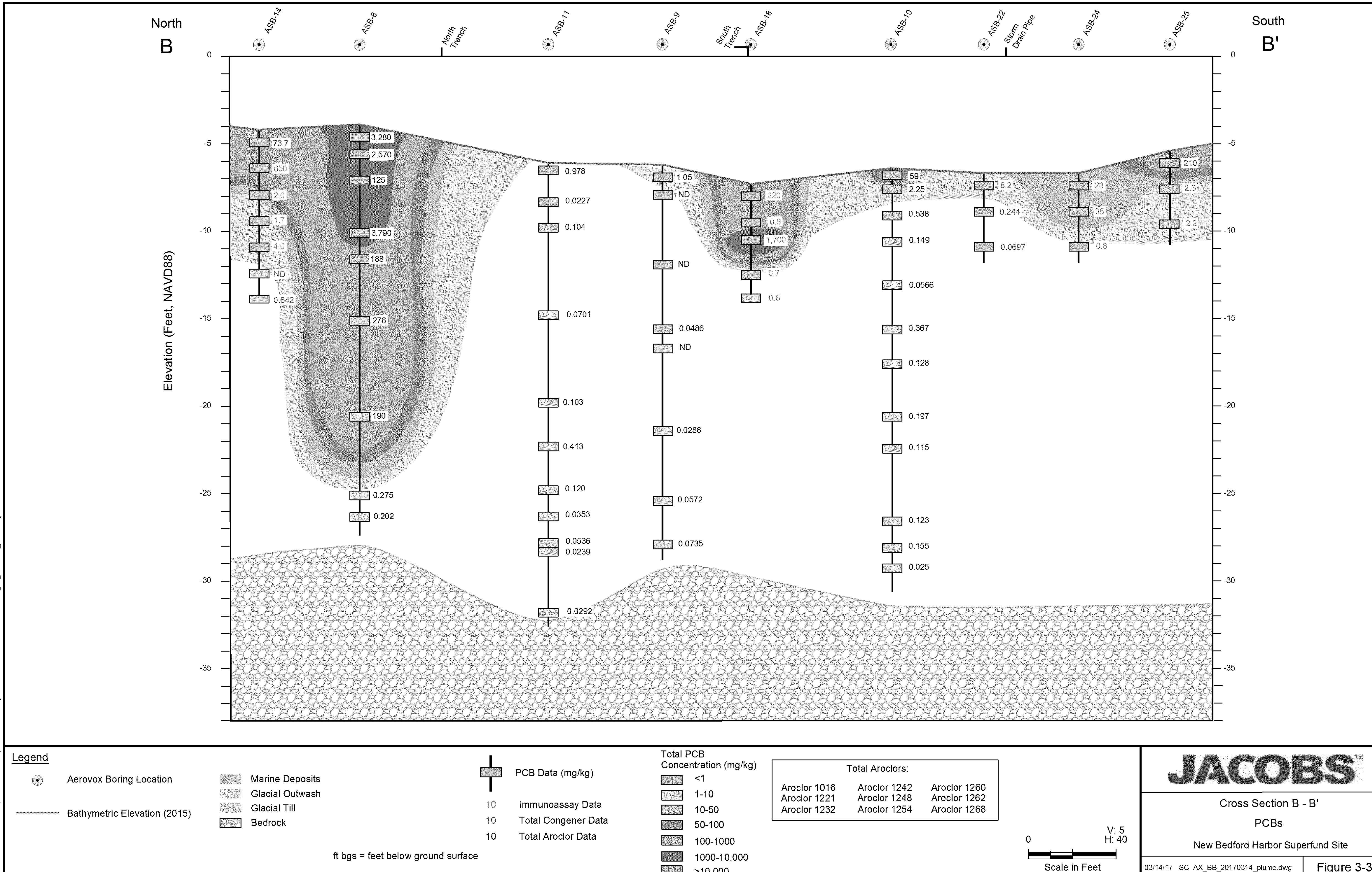

North
B
South
B'
ASB-14
ASB-8
North Trench
ASB-11
ASB-9
South Trench
ASB-18
ASB-10
ASB-22
Storm Drain Pipe
ASB-24
ASB-25
Elevation (Feet, NAVD88)
0
-5
-10
-15
-20
-25
-30
-35
73.7
650
2.0
1.7
4.0
ND
0.642
3,280
2,570
125
3,790
188
276
190
0.275
0.202
0.978
0.0227
0.104
0.0701
0.103
0.413
0.120
0.0353
0.0536
0.0239
0.0292
1.05
ND
ND
0.0486
ND
0.0286
0.0572
0.0735
220
0.8
1,700
0.7
0.6
59
2.25
0.538
0.149
0.0566
0.367
0.128
0.197
0.115
0.123
0.155
0.025
8.2
0.244
0.0697
23
35
0.8
210
2.3
2.2
Legend
Aerovox Boring Location
Bathymetric Elevation (2015)
Marine Deposits
Glacial Outwash
Glacial Till
Bedrock
PCB Data (mg/kg)
10 Immunoassay Data
10 Total Congener Data
10 Total Aroclor Data
ft bgs = feet below ground surface
Total PCB Concentration (mg/kg)
<1
1-10
10-50
50-100
100-1000
1000-10,000
>10,000
Total Aroclors:
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
0
V: 5
H: 40
Scale in Feet
JACOBS
Cross Section B - B'
PCBs
New Bedford Harbor Superfund Site
03/14/17 SC AX_BB_20170314_plume.dwg
Figure 3-3
Y:\NBH\Projects\35BG1001\20170314\AutoCAD\AX_BB_20170314_plume.dwg
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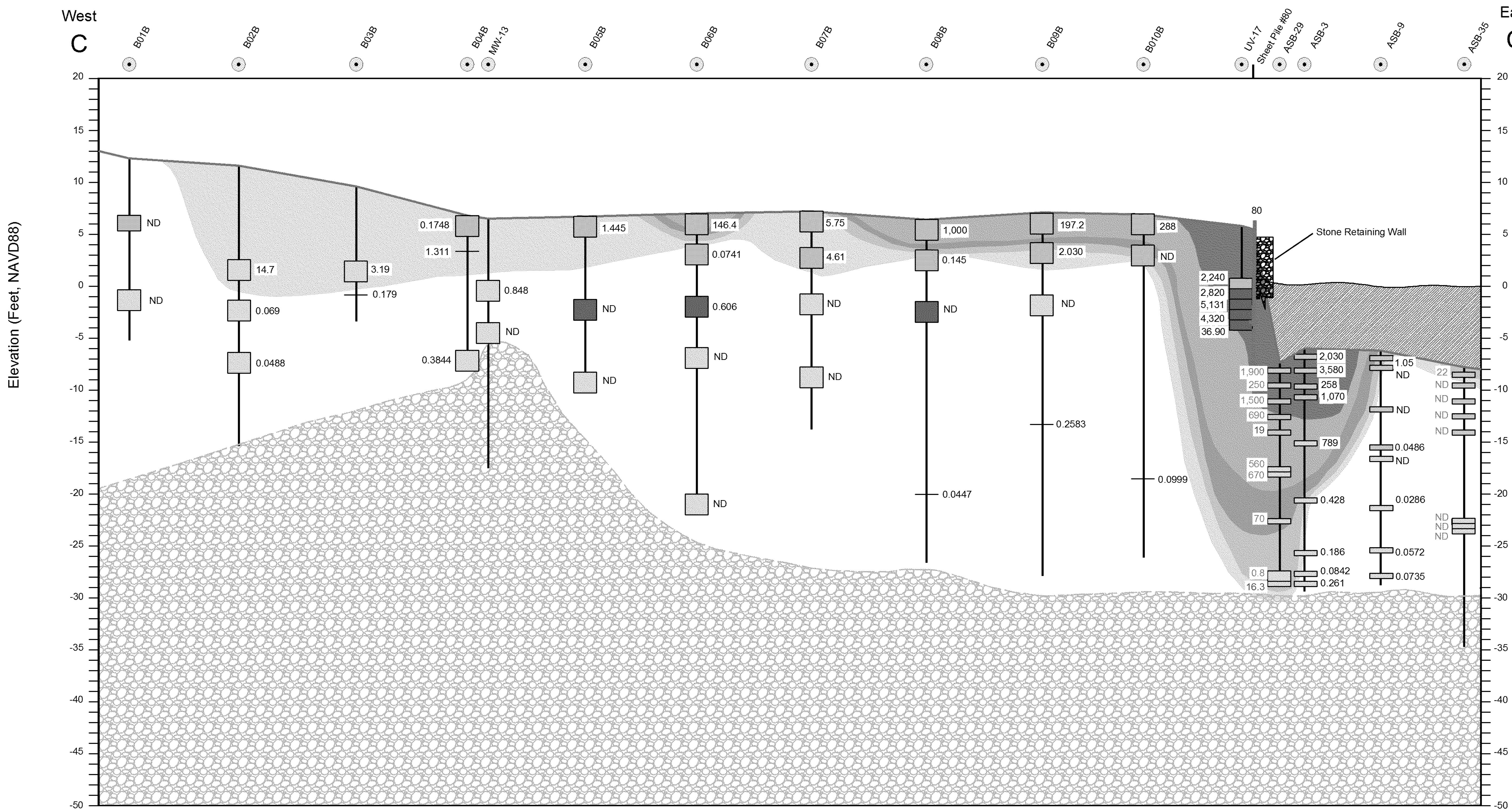


## Legend

- Aerovox Boring Location
- Bathymetric Elevation (2015)
- Harbor Water
- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Gravel
- Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

PCB Data (mg/kg)

10 Immunoassay Data

10 Total Congener Data

10 Total Aroclor Data

Total PCB Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

| Total Aroclors: | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

0 V: 10 H: 80

Scale in Feet

JACOBS

Cross Section C - C'

PCBs

New Bedford Harbor Superfund Site

03/14/17 SC AX_CC_20170314_plume.dwg

Figure 3-4


Legend

- Aerovox Boring Location
- Aerovox Cross Section Location
- Sheet Pile Location

**Total PCB**

**Concentration (mg/kg)**

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

**Deep Soils/Sediments**
**Aerovox Site: >13 ft bgs**
**New Bedford Harbor: >7 ft bgs**

Aerial Photography MASSGIS 2014

N

0 50 100 Feet

1:1,200

**JACOBS**

**PCB Distribution for Former Aerovox Site Area Deep Soils/Sediments**

New Bedford Harbor Superfund Site

Date: 1/24/2017

**Figure 3-5**

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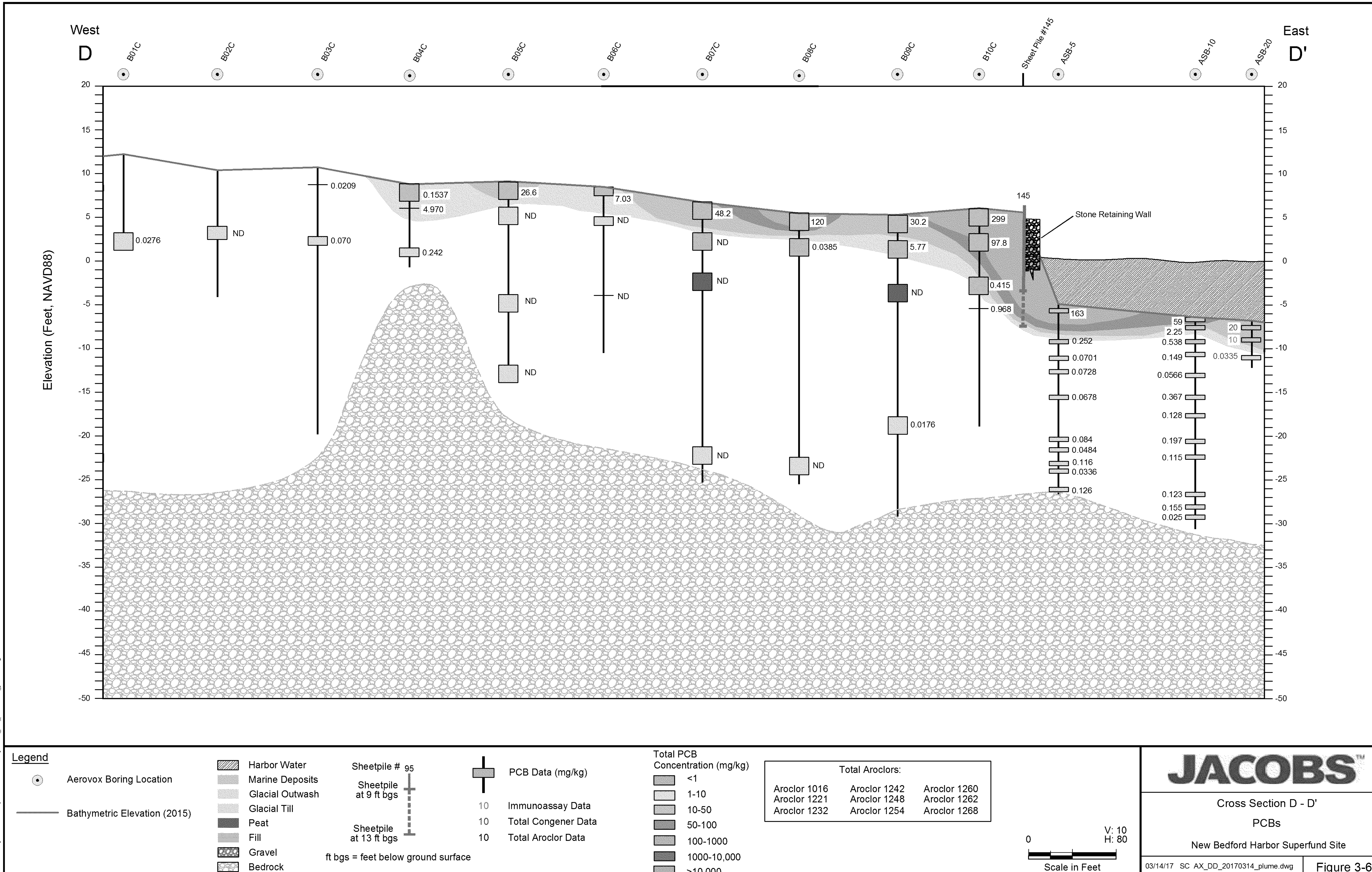
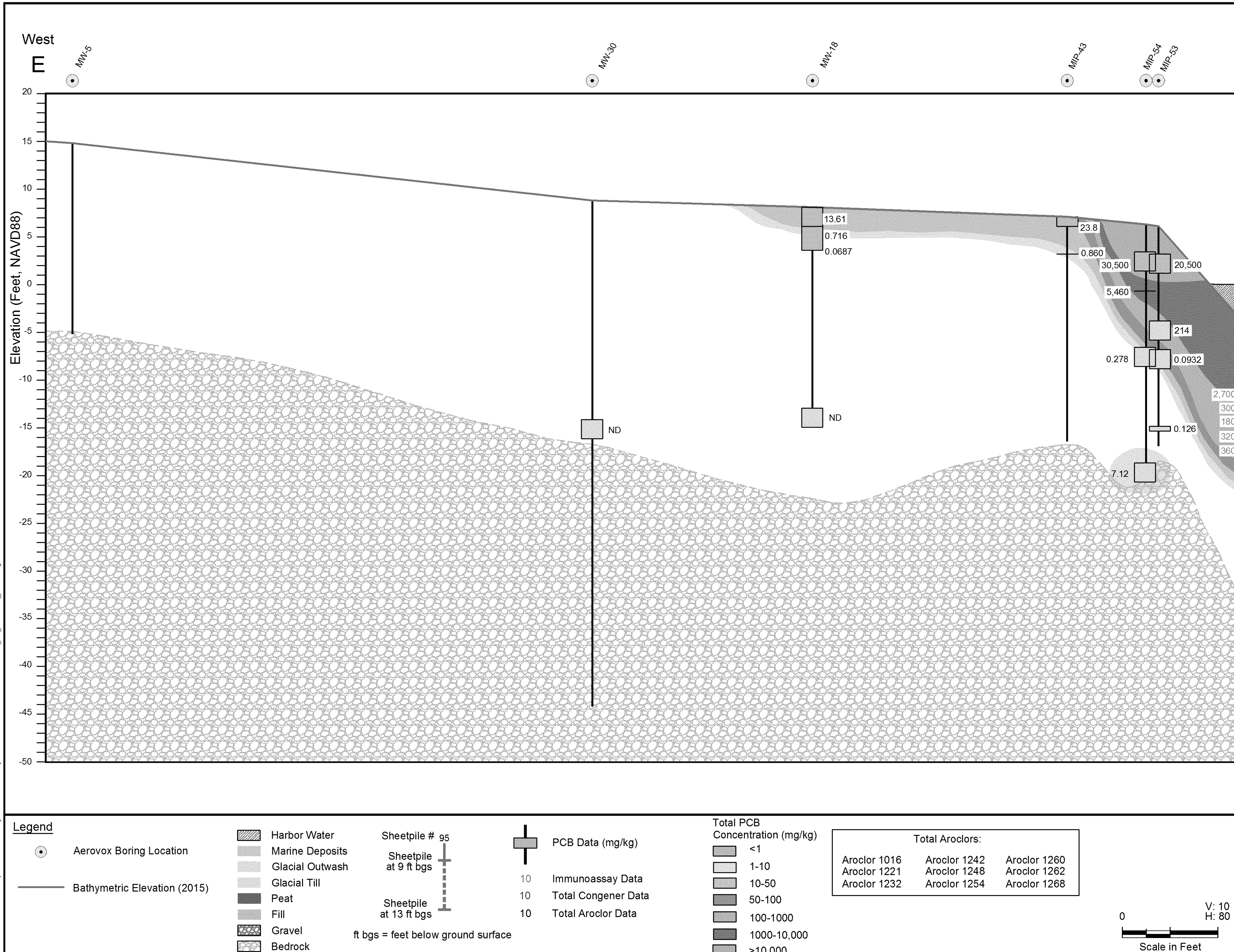


Cross Section D - D'
PCBs
New Bedford Harbor Superfund Site
Figure 3-6




JACOBS

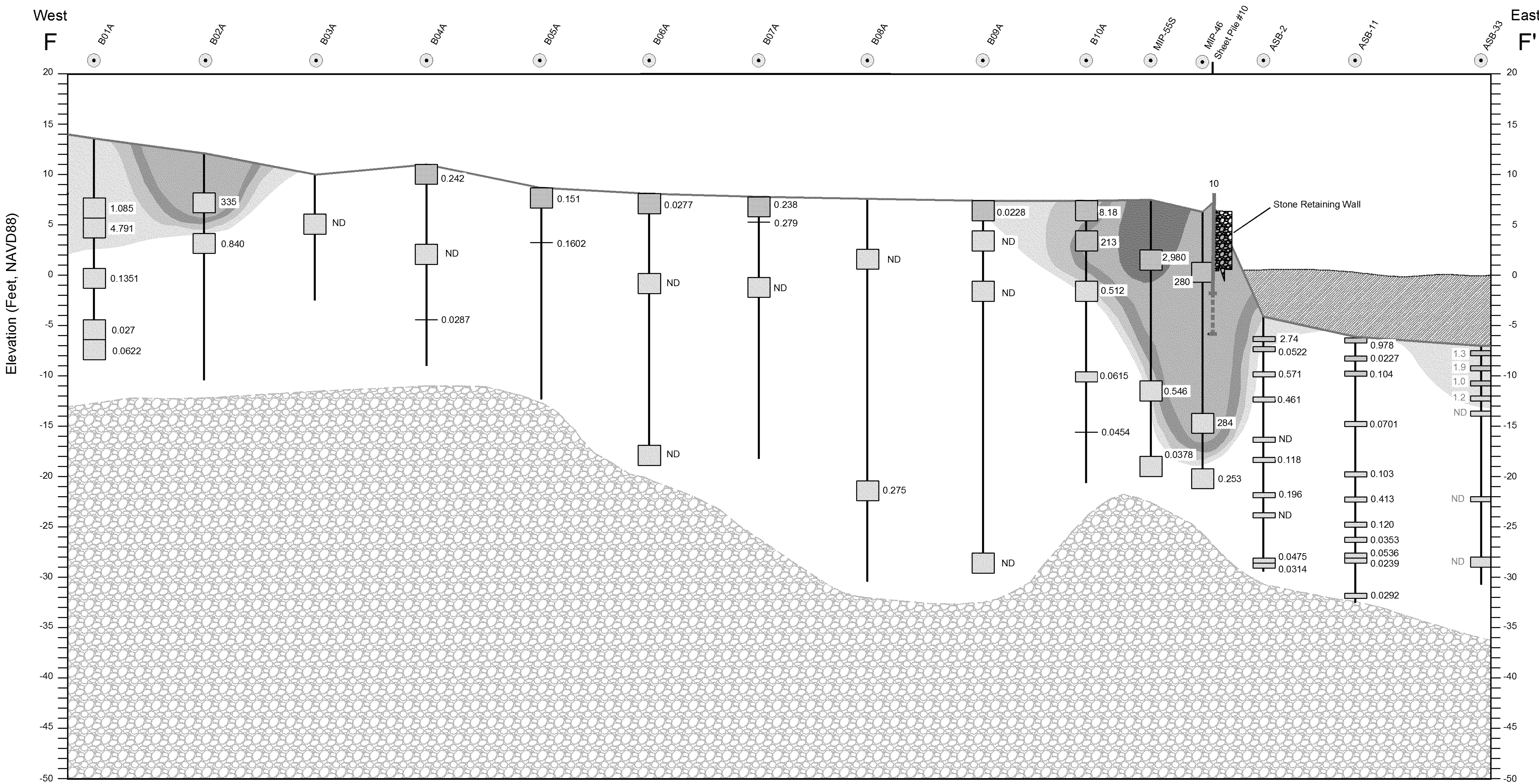
Cross Section E - E'

PCBs

New Bedford Harbor Superfund Site

03/14/17 SC AX_EE_20170314_plume.dwg

Figure 3-7




Legend

- Aerovox Boring Location
- Bathymetric Elevation (2015)

Harbor Water
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Gravel
Bedrock

Sheetpile # 95
Sheetpile at 9 ft bgs
Sheetpile at 13 ft bgs
ft bgs = feet below ground surface

PCB Data (mg/kg)
10 Immunoassay Data
10 Total Congener Data
10 Total Aroclor Data

Total PCB Concentration (mg/kg)
- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total Aroclors:

| | | |
|---|---|---|
| Aroclor 1016 | Aroclor 1242 | Aroclor 1260 |
| Aroclor 1221 | Aroclor 1248 | Aroclor 1262 |
| Aroclor 1232 | Aroclor 1254 | Aroclor 1268 |

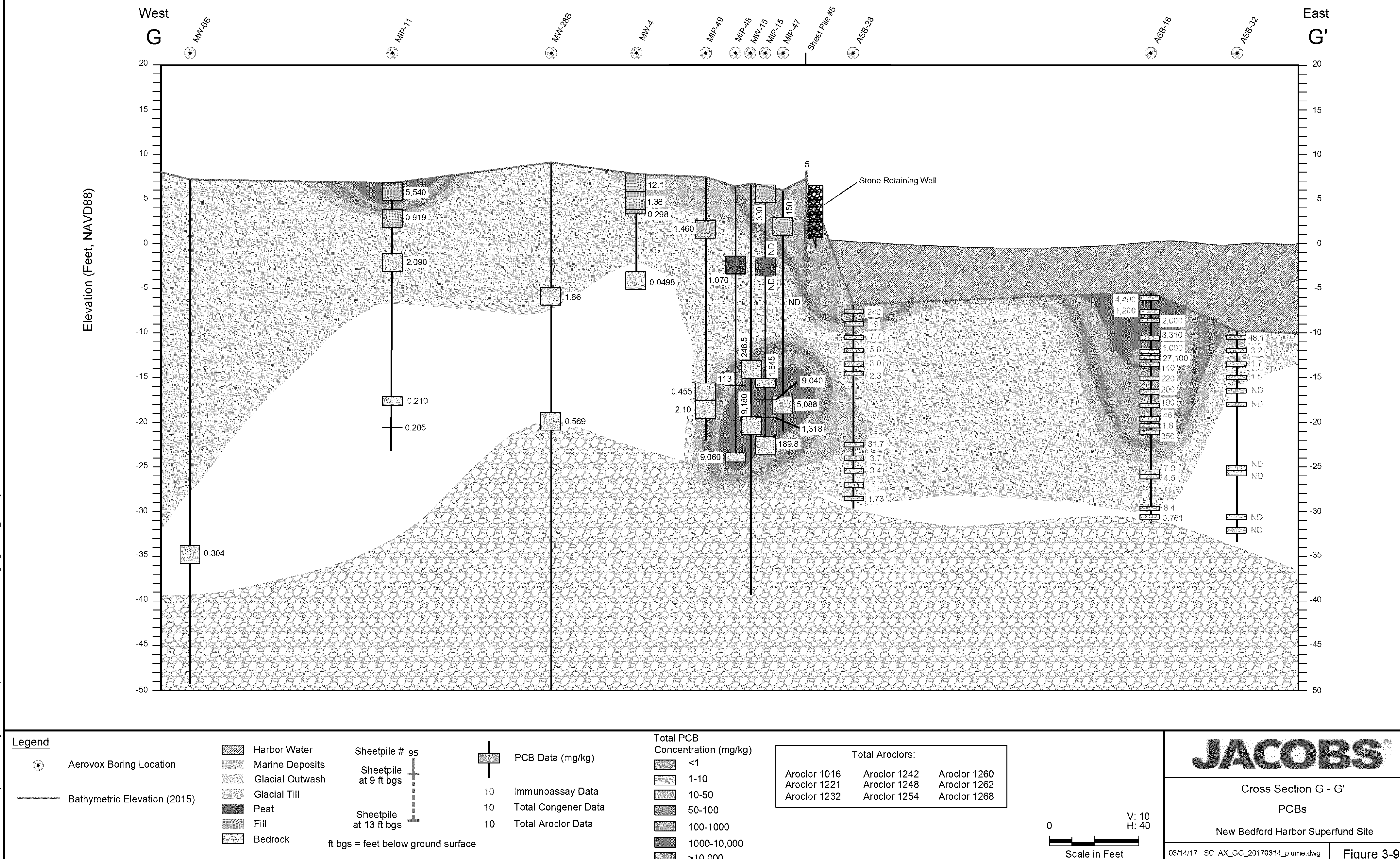
0 Scale in Feet V: 10 H: 80

JACOBS

Cross Section F - F'
PCBs
New Bedford Harbor Superfund Site

03/14/17 SC AX_FF_20170314_plume.dwg

Figure 3-8




JACOBS

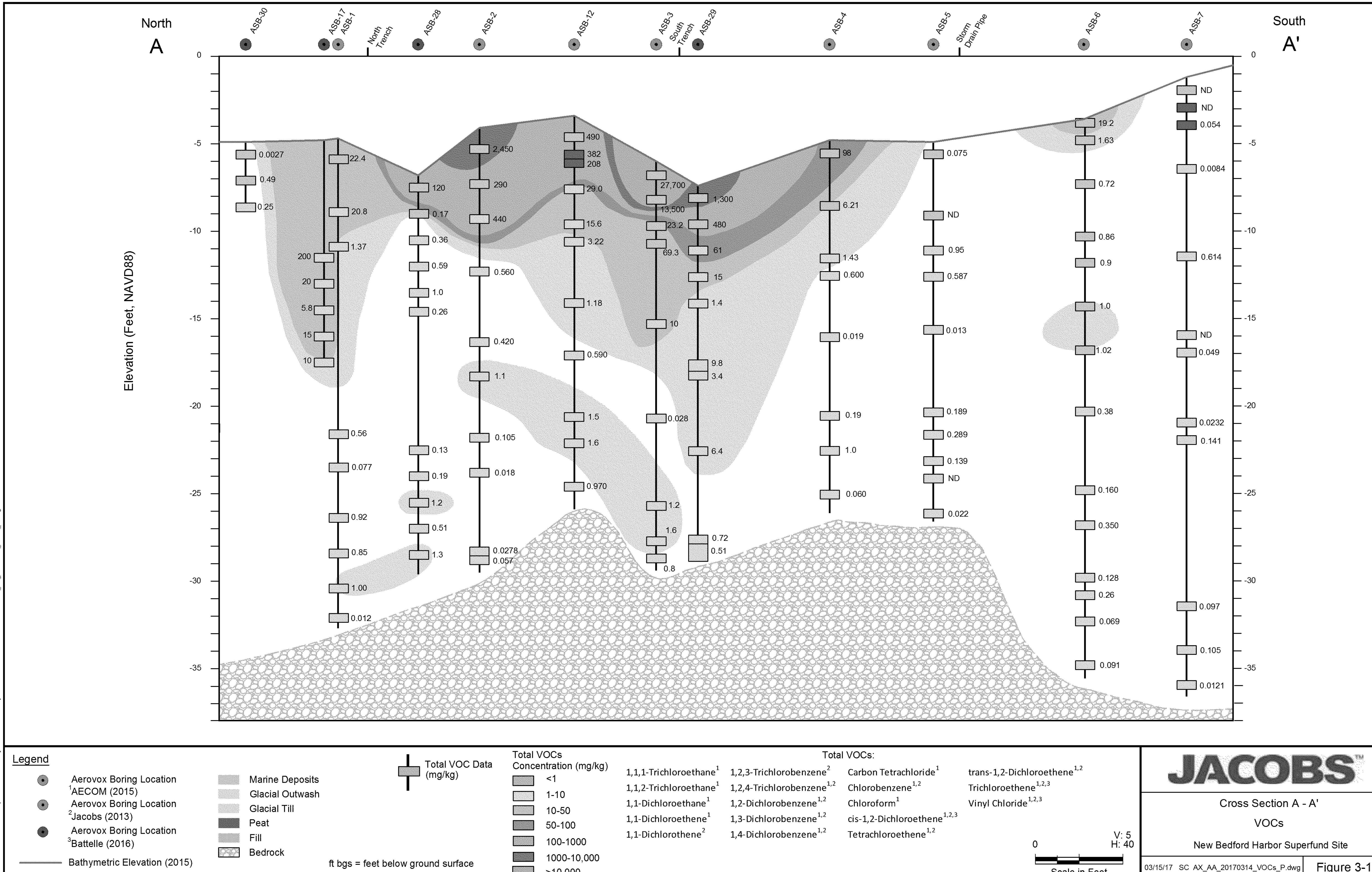
Cross Section G - G'

PCBs

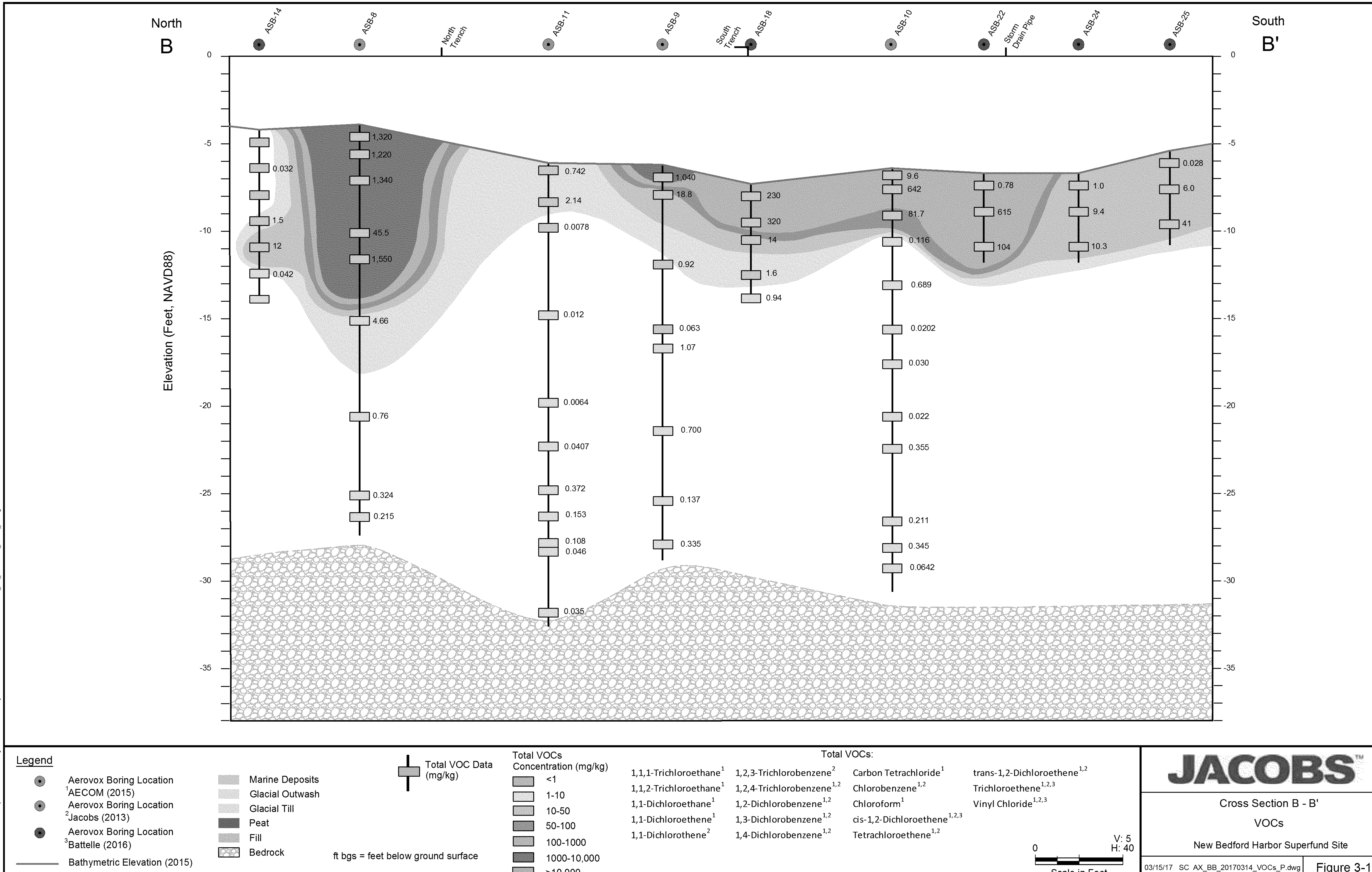
New Bedford Harbor Superfund Site

03/14/17 SC AX_GG_20170314_plume.dwg

Figure 3-9

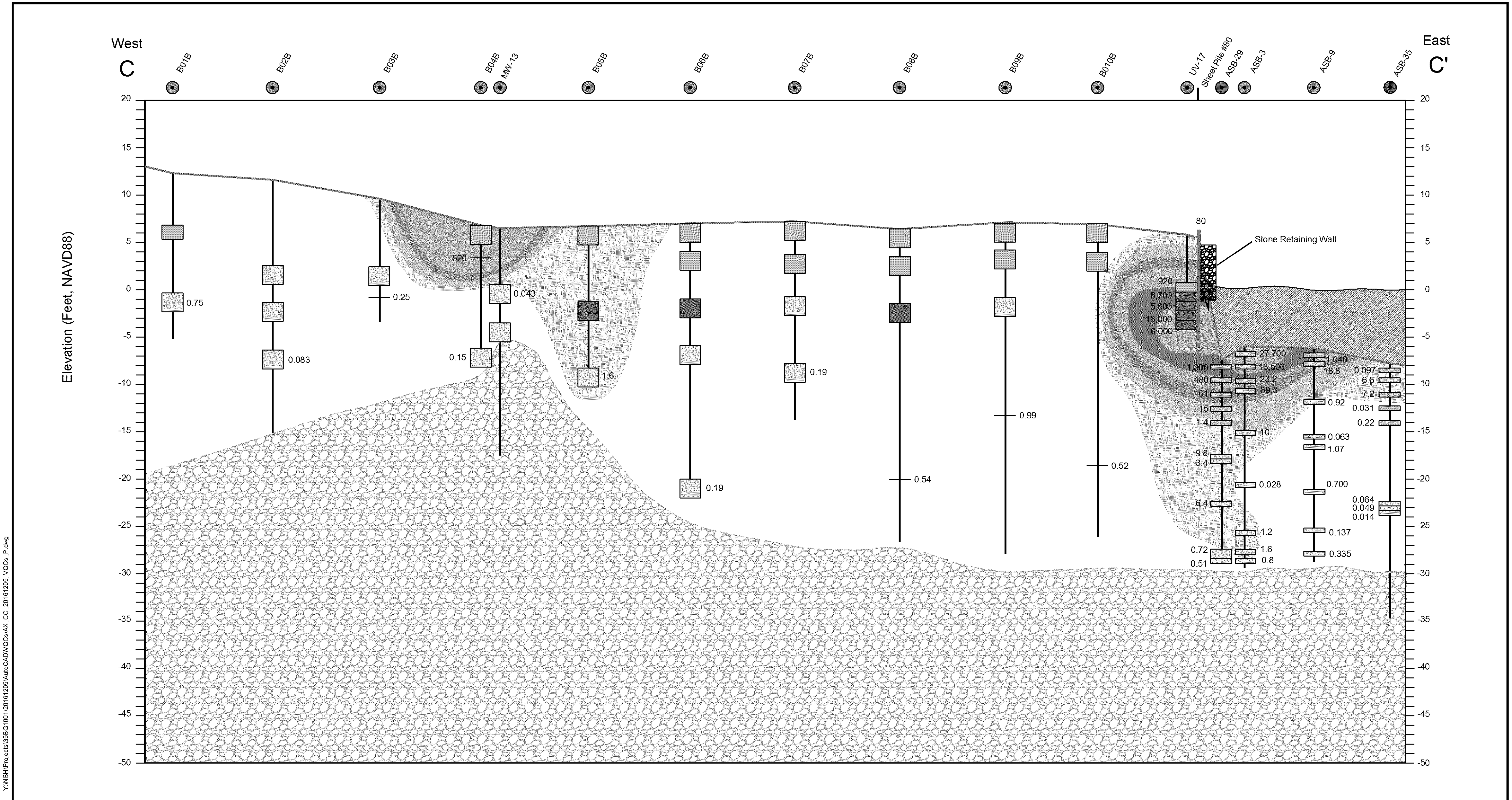


North
A
South
A'
ASB-30
ASB-17
ASB-1
North Trench
ASB-28
ASB-2
ASB-12
ASB-3
South Trench
ASB-29
ASB-4
ASB-5
Storm Drain Pipe
ASB-6
ASB-7
Elevation (Feet, NAVD88)
0
-5
-10
-15
-20
-25
-30
-35
0.0027
0.49
0.25
22.4
20.8
1.37
200
20
5.8
15
10
0.56
0.077
0.92
0.85
1.00
0.012
120
0.17
0.36
0.59
1.0
0.26
0.13
0.19
1.2
0.51
1.3
2,450
290
440
0.560
0.420
1.1
0.105
0.018
0.0278
0.057
490
382
208
29.0
15.6
3.22
1.18
0.590
1.5
1.6
0.970
27,700
13,500
23.2
69.3
10
0.028
1.2
1.6
0.8
1,300
480
61
15
1.4
9.8
3.4
6.4
0.72
0.51
98
6.21
1.43
0.600
0.019
0.19
1.0
0.060
0.075
ND
0.95
0.587
0.013
0.189
0.289
0.139
ND
0.022
19.2
1.63
0.72
0.86
0.9
1.0
1.02
0.38
0.160
0.350
0.128
0.26
0.069
0.091
ND
ND
0.054
0.0084
0.614
ND
0.049
0.0232
0.141
0.097
0.105
0.0121
Legend
Aerovox Boring Location 1AECOM (2015)
Aerovox Boring Location 2Jacobs (2013)
Aerovox Boring Location 3Battelle (2016)
Bathymetric Elevation (2015)
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Bedrock
Total VOC Data (mg/kg)
ft bgs = feet below ground surface
Total VOCs Concentration (mg/kg)
<1
1-10
10-50
50-100
100-1000
1000-10,000
>10,000
Total VOCs:
1,1,1-Trichloroethane1
1,1,2-Trichloroethane1
1,1-Dichloroethane1
1,1-Dichloroethene1
1,1-Dichlorothene2
1,2,3-Trichlorobenzene2
1,2,4-Trichlorobenzene1,2
1,2-Dichlorobenzene1,2
1,3-Dichlorobenzene1,2
1,4-Dichlorobenzene1,2
Carbon Tetrachloride1
Chlorobenzene1,2
Chloroform1
cis-1,2-Dichloroethene1,2,3
Tetrachloroethene1,2
trans-1,2-Dichloroethene1,2
Trichloroethene1,2,3
Vinyl Chloride1,2,3
0
V: 5
H: 40
Scale in Feet
JACOBS
Cross Section A - A'
VOCs
New Bedford Harbor Superfund Site
03/15/17 SC AX_AA_20170314_VOCs_P.dwg
Figure 3-10
last modified: 03/15/17 printed: 03/15/17 by sc Y:\NBH\Projects\35BG1001\20170314\AutoCAD\AX_AA_20170314_VOCs_P.dwg



North
B
South
B'
ASB-14
ASB-8
North Trench
ASB-11
ASB-9
South Trench
ASB-18
ASB-10
ASB-22
Storm Drain Pipe
ASB-24
ASB-25
Elevation (Feet, NAVD88)
0
-5
-10
-15
-20
-25
-30
-35
0.032
1.5
12
0.042
1,320
1,220
1,340
45.5
1,550
4.66
0.76
0.324
0.215
0.742
2.14
0.0078
0.012
0.0064
0.0407
0.372
0.153
0.108
0.046
0.035
1,040
18.8
0.92
0.063
1.07
0.700
0.137
0.335
230
320
14
1.6
0.94
9.6
642
81.7
0.116
0.689
0.0202
0.030
0.022
0.355
0.211
0.345
0.0642
0.78
615
104
1.0
9.4
10.3
0.028
6.0
41
Legend
Aerovox Boring Location
¹AECOM (2015)
Aerovox Boring Location
²Jacobs (2013)
Aerovox Boring Location
³Battelle (2016)
Bathymetric Elevation (2015)
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Bedrock
Total VOC Data (mg/kg)
ft bgs = feet below ground surface
Total VOCs Concentration (mg/kg)
<1
1-10
10-50
50-100
100-1000
1000-10,000
>10,000
Total VOCs:
1,1,1-Trichloroethane[1]
1,1,2-Trichloroethane[1]
1,1-Dichloroethane[1]
1,1-Dichloroethene[1]
1,1-Dichlorothene[2]
1,2,3-Trichlorobenzene[2]
1,2,4-Trichlorobenzene[1,2]
1,2-Dichlorobenzene[1,2]
1,3-Dichlorobenzene[1,2]
1,4-Dichlorobenzene[1,2]
Carbon Tetrachloride[1]
Chlorobenzene[1,2]
Chloroform[1]
cis-1,2-Dichloroethene[1,2,3]
Tetrachloroethene[1,2]
trans-1,2-Dichloroethene[1,2]
Trichloroethene[1,2,3]
Vinyl Chloride[1,2,3]
0
V: 5
H: 40
Scale in Feet
JACOBS
Cross Section B - B'
VOCs
New Bedford Harbor Superfund Site
03/15/17 SC AX_BB_20170314_VOCs_P.dwg

Figure 3-11




Legend

- Aerovox Boring Location [1]AECOM (2015)
- Aerovox Boring Location [2]Jacobs (2013)
- Aerovox Boring Location [3]Battelle (2016)
- Bathy Elevation

- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

Total VOC Data (mg/kg)

Total VOCs Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total VOCs:

| | | | |
|---|---|---|---|
| 1,1,1-Trichloroethane[1] | 1,2,3-Trichlorobenzene[2] | Carbon Tetrachloride[1] | trans-1,2-Dichloroethene[1,2] |
| 1,1,2-Trichloroethane[1] | 1,2,4-Trichlorobenzene[1,2] | Chlorobenzene[1,2] | Trichloroethene[1,2,3] |
| 1,1-Dichloroethane[1] | 1,2-Dichlorobenzene[1,2] | Chloroform[1] | Vinyl Chloride[1,2,3] |
| 1,1-Dichloroethene[1] | 1,3-Dichlorobenzene[1,2] | cis-1,2-Dichloroethene[1,2,3] | |
| 1,1-Dichlorothene[2] | 1,4-Dichlorobenzene[1,2] | Tetrachloroethene[1,2] | |

0 V: 10 H: 80

Scale in Feet

JACOBS™

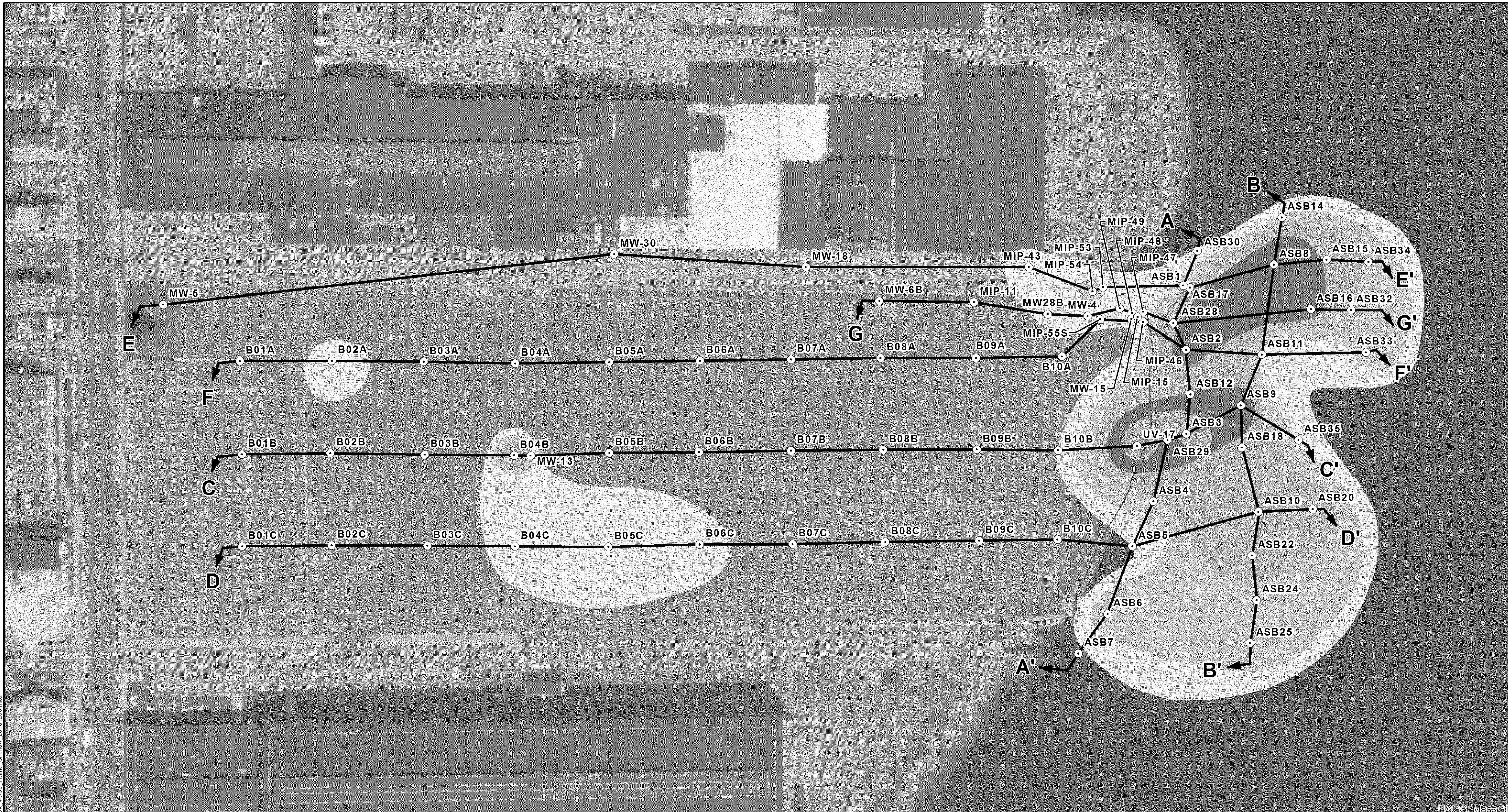
Cross Section C - C' VOCs

New Bedford Harbor Superfund Site

01/24/17 SC AX_CC_20161205_VOCs_P.dwg

Figure 3-12

last modified: 01/24/17 printed: 01/24/17 by sc Y:\NBH\Projects\35BG1001\20161205\AutoCAD\VOCs\AX_CC_20161205_VOCs_P.dwg




Path: Y:\NBH\Projects\35BG1001\20161205\ArcGIS\Aerovox_VOCs_Plume_Shallow_20161206.mxd

Legend

- Aerovox Boring Location
- Aerovox Cross Section Location
- Sheet Pile Location

**Total VOC**

**Concentration (mg/kg)**

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

**Shallow Soils/Sediments**
**Aerovox Site: 0-13 ft bgs**
**New Bedford Harbor: 0-7 ft bgs**

Aerial Photography MASSGIS 2014

N

0 50 100
Feet

1:1,200

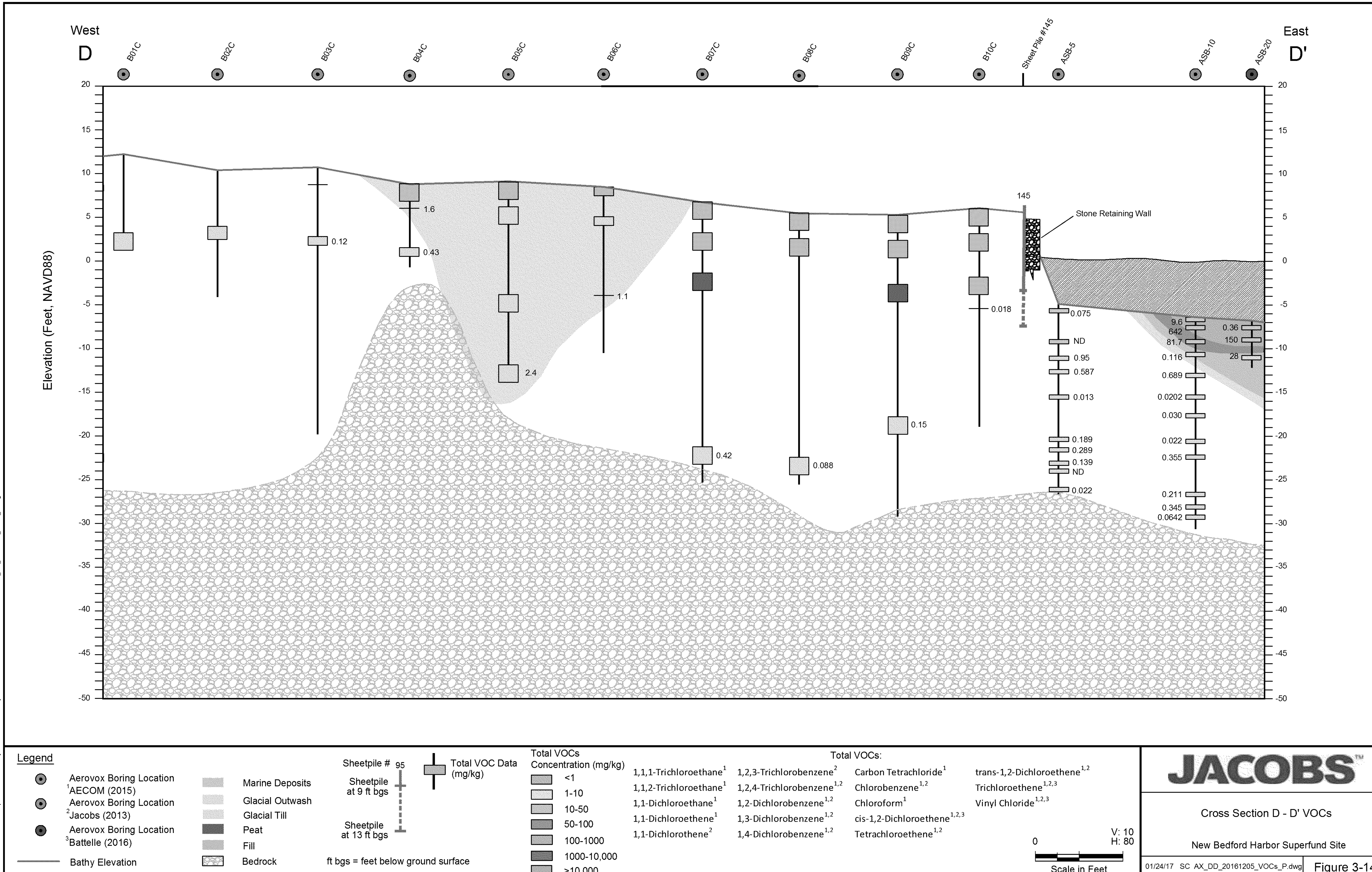
**JACOBS**

**VOC Distribution for Former Aerovox Site Area Shallow Soils/Sediments**

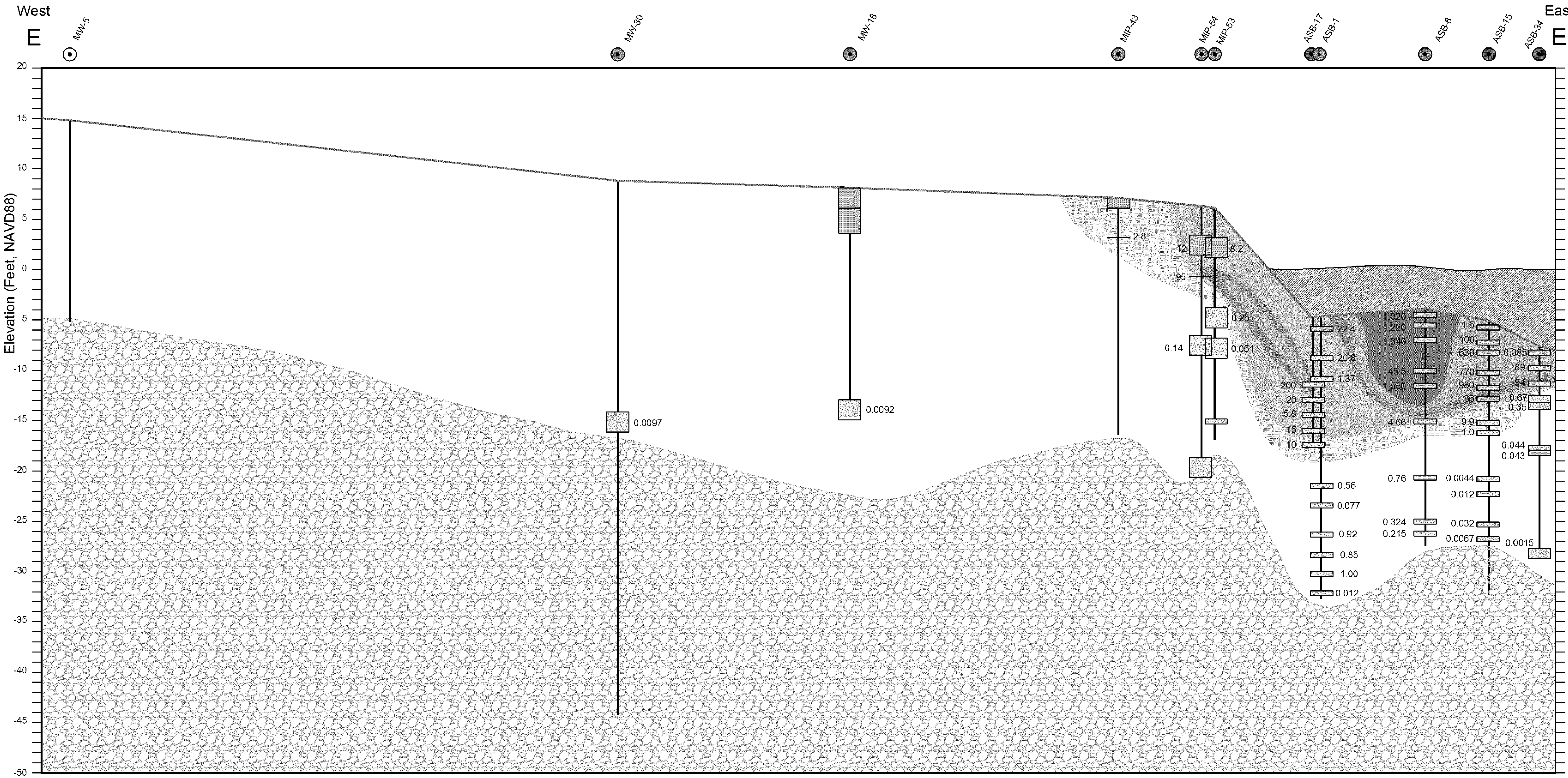
New Bedford Harbor Superfund Site

Date: 1/24/2017

**Figure 3-13**



West
D
East
D'
B01C
B02C
B03C
B04C
B05C
B06C
B07C
B08C
B09C
B10C
Sheet Pile #145
ASB-5
ASB-10
ASB-20
Elevation (Feet, NAVD88)
145
Stone Retaining Wall
1.6
0.12
0.43
1.1
2.4
0.018
0.42
0.088
0.15
0.075
ND
0.95
0.587
0.013
0.189
0.289
0.139
ND
0.022
9.6
642
81.7
0.116
0.689
0.0202
0.030
0.022
0.355
0.211
0.345
0.0642
0.36
150
28
Legend
Aerovox Boring Location AECOM (2015)[1]
Aerovox Boring Location Jacobs (2013)[2]
Aerovox Boring Location Battelle (2016)[3]
Bathy Elevation
Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Bedrock
Sheetpile # 95
Sheetpile at 9 ft bgs
Sheetpile at 13 ft bgs
Total VOC Data (mg/kg)
ft bgs = feet below ground surface
Total VOCs Concentration (mg/kg)
<1
1-10
10-50
50-100
100-1000
1000-10,000
>10,000
Total VOCs:
1,1,1-Trichloroethane[1]
1,1,2-Trichloroethane[1]
1,1-Dichloroethane[1]
1,1-Dichloroethene[1]
1,1-Dichlorothene[2]
1,2,3-Trichlorobenzene[2]
1,2,4-Trichlorobenzene[1,2]
1,2-Dichlorobenzene[1,2]
1,3-Dichlorobenzene[1,2]
1,4-Dichlorobenzene[1,2]
Carbon Tetrachloride[1]
Chlorobenzene[1,2]
Chloroform[1]
cis-1,2-Dichloroethene[1,2,3]
Tetrachloroethene[1,2]
trans-1,2-Dichloroethene[1,2]
Trichloroethene[1,2,3]
Vinyl Chloride[1,2,3]
V: 10
H: 80
0
Scale in Feet
JACOBS
Cross Section D - D' VOCs
New Bedford Harbor Superfund Site
01/24/17 SC AX_DD_20161205_VOCs_P.dwg
Figure 3-14




Legend

Aerovox Boring Location
[1]AECOM (2015)

Aerovox Boring Location
[2]Jacobs (2013)

Aerovox Boring Location
[3]Battelle (2016)

Bathy Elevation

Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Bedrock

Sheetpile # 95

Sheetpile at 9 ft bgs

Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

Total VOC Data (mg/kg)

Total VOCs Concentration (mg/kg)
- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total VOCs:

1,1,1-Trichloroethane[1]
1,1,2-Trichloroethane[1]
1,1-Dichloroethane[1]
1,1-Dichloroethene[1]
1,1-Dichlorothene[2]
1,2,3-Trichlorobenzene[2]
1,2,4-Trichlorobenzene[1,2]
1,2-Dichlorobenzene[1,2]
1,3-Dichlorobenzene[1,2]
1,4-Dichlorobenzene[1,2]
Carbon Tetrachloride[1]
Chlorobenzene[1,2]
Chloroform[1]
cis-1,2-Dichloroethene[1,2,3]
Tetrachloroethene[1,2]
trans-1,2-Dichloroethene[1,2]
Trichloroethene[1,2,3]
Vinyl Chloride[1,2,3]

0 V: 10 H: 80
Scale in Feet

JACOBS™

Cross Section E - E' VOCs

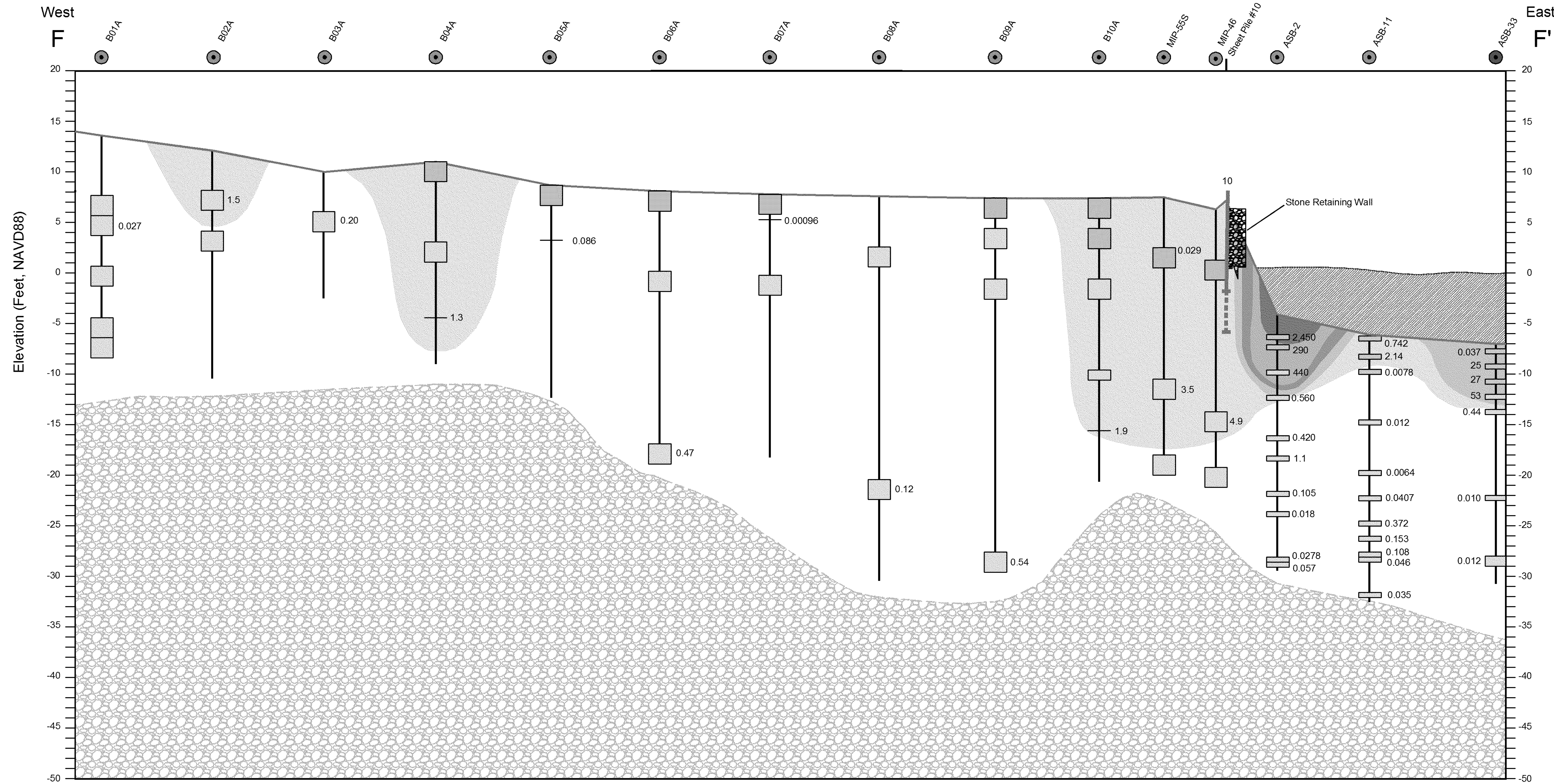
New Bedford Harbor Superfund Site

01/24/17 SC AX_EE_20161205_VOCs_P.dwg

Figure 3-15

Y:\NBH\Projects\35BG1001\20161205\AutoCAD\VOCs\AX_EE_20161205_VOCs_P.dwg

last modified: 01/24/17 printed: 01/24/17 by sc




Legend

- Aerovox Boring Location [1]AECOM (2015)
- Aerovox Boring Location [2]Jacobs (2013)
- Aerovox Boring Location [3]Battelle (2016)
- Bathy Elevation
- Marine Deposits
- Glacial Outwash
- Glacial Till
- Peat
- Fill
- Bedrock

Sheetpile # 95
Sheetpile at 9 ft bgs
Sheetpile at 13 ft bgs

Total VOC Data (mg/kg)

ft bgs = feet below ground surface

Total VOCs Concentration (mg/kg)

- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total VOCs:

1,1,1-Trichloroethane[1]
1,1,2-Trichloroethane[1]
1,1-Dichloroethane[1]
1,1-Dichloroethene[1]
1,1-Dichlorothene[2]
1,2,3-Trichlorobenzene[2]
1,2,4-Trichlorobenzene[1,2]
1,2-Dichlorobenzene[1,2]
1,3-Dichlorobenzene[1,2]
1,4-Dichlorobenzene[1,2]
Carbon Tetrachloride[1]
Chlorobenzene[1,2]
Chloroform[1]
cis-1,2-Dichloroethene[1,2,3]
Tetrachloroethene[1,2]
trans-1,2-Dichloroethene[1,2]
Trichloroethene[1,2,3]
Vinyl Chloride[1,2,3]

0 Scale in Feet V: 10 H: 80

JACOBS™

Cross Section F - F' VOCs

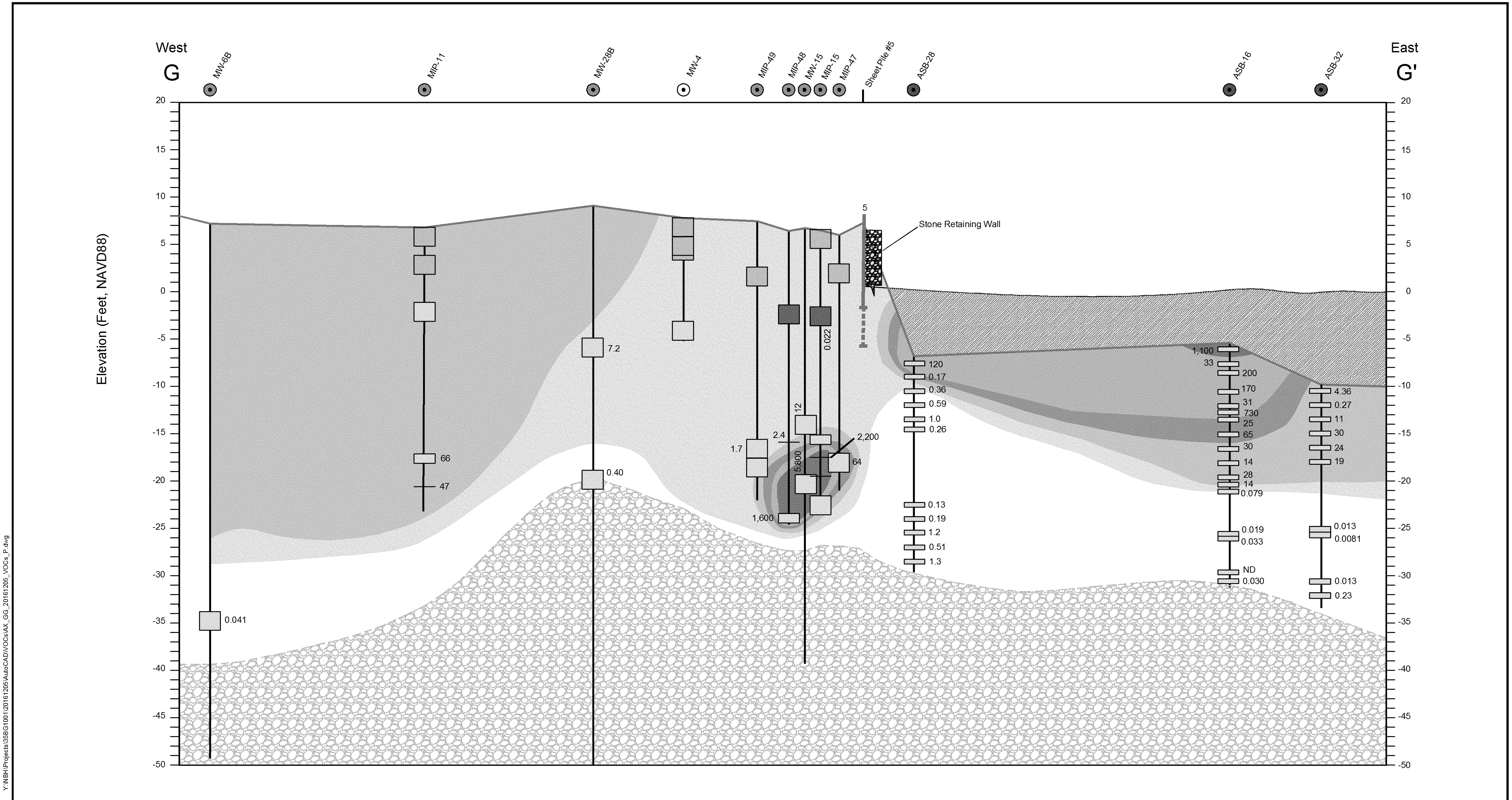
New Bedford Harbor Superfund Site

01/24/17 SC AX_FF_20161205_VOCs_P.dwg

Figure 3-16

Y:\NBH\Projects\35BG1001\20161205\AutoCAD\VOCs\AX_FF_20161205_VOCs_P.dwg

last modified: 01/24/17 printed: 01/24/17 by sc




## Legend

- Aerovox Boring Location [1]AECOM (2015)
- Aerovox Boring Location [2]Jacobs (2013)
- Aerovox Boring Location [3]Battelle (2016)
- Bathy Elevation

Marine Deposits
Glacial Outwash
Glacial Till
Peat
Fill
Bedrock

Sheetpile # 95
Sheetpile at 9 ft bgs
Sheetpile at 13 ft bgs

ft bgs = feet below ground surface

Total VOC Data (mg/kg)

Total VOCs Concentration (mg/kg)
- <1
- 1-10
- 10-50
- 50-100
- 100-1000
- 1000-10,000
- >10,000

Total VOCs:

| | | | |
|---|---|---|---|
| 1,1,1-Trichloroethane[1] | 1,2,3-Trichlorobenzene[2] | Carbon Tetrachloride[1] | trans-1,2-Dichloroethene[1,2] |
| 1,1,2-Trichloroethane[1] | 1,2,4-Trichlorobenzene[1,2] | Chlorobenzene[1,2] | Trichloroethene[1,2,3] |
| 1,1-Dichloroethane[1] | 1,2-Dichlorobenzene[1,2] | Chloroform[1] | Vinyl Chloride[1,2,3] |
| 1,1-Dichloroethene[1] | 1,3-Dichlorobenzene[1,2] | cis-1,2-Dichloroethene[1,2,3] | |
| 1,1-Dichlorothene[2] | 1,4-Dichlorobenzene[1,2] | Tetrachloroethene[1,2] | |

0 V: 10 H: 40
Scale in Feet

JACOBS™

Cross Section G - G' VOCs

New Bedford Harbor Superfund Site

01/24/17 SC AX_GG_20161205_VOCs_P.dwg

Figure 3-17


Legend

- Aerovox Boring Location
- Aerovox Cross Section Location
- Sheet Pile Location

**Total VOC**

**Concentration (mg/kg)**

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

**Deep Soils/Sediments**
**Aerovox Site: >13 ft bgs**
**New Bedford Harbor: >7 ft bgs**

Aerial Photography MASSGIS 2014

0 50 100
Feet
1:1,200

**JACOBS**

**VOC Distribution for Former Aerovox Site Area Deep Soils/Sediments**

New Bedford Harbor Superfund Site

Date: 1/24/2017

**Figure 3-18**

Path: Y:\NBH\Projects\35BG1001\20161205\ArcGIS\Aerovox_VOCs_Plume_Deep_20161206.mxd